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# WILDLIFE LABORATORY

## • annual report •

DECEMBER 1994

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# JOB PROGRESS REPORT

State: Montana

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| Project No.: W-120-R-15 | Project Title: | Statewide Wildlife Research |
| Element No.: VI | Element Title: | Wildlife Investigations Laboratory |
| Sub-project No.: 2 | Sub-project Title: | Research and Technical Services |
| Study No.: WI-1.0 | Study Title: | Wildlife Laboratory |
| Job No.: 1 | Job Title: | Statewide Wildlife Laboratory Services |

Period Covered: July 1, 1993 - June 30, 1994

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Since this is a progress report only, results presented herein are not necessarily final and may be subject to change. For this reason, the information contained in this report may not be published or used for other purposes without permission of the Director.

## ABSTRACT

The Wildlife Laboratory processed 267 general wildlife specimens and 874 hunter/trapper specimens. Approximately 200 big game and furbearer samples were analyzed for food habits. Blood samples from 200 animals of several species were analyzed for disease and chemistry profiles. Reproductive tracts from 100 animals of several species were analyzed for reproductive performance. Approximately 200 skulls were cleaned to be stored in reference collections or used in wildlife education. Over 1,300 teeth were collected and submitted for age determination by cementum annuli counts. Ages were determined for 83 bear, 390 furbearing animals, 364 bobcat, 2 wolves, and 500 mountain lion. Tests were conducted on aging techniques for mountain lion, marten, and bobcat. Tissue and blood samples were collected from 41 deer during a disease surviellance project conducted by an MSU graduate student. Laboratory personnel participated in a surviellance for tuberculosis near game farms, and for plague and canine distemper in proposed black-footed ferret reintroduction sites. Fifty one animal necropsies were conducted on a variety of species. A total of $25,695 was grossed during the sale of 116 hides, heads, and other items auctioned in the annual trophy sale. Twelve laboratory reports were written reporting the results of hair analysis, necropsies, food habit analysis, and animal condition tests. Sixteen requests for reference specimens and educational material were processed. Materials for wildlife education were loaned out to teachers and wildlife educators 110 times. The biotelemetry frequency database was updated and results reported to the FCC frequency coordination committee. Animal immobilization throughout the state was coordinated. Work continued on monitoring of wildlife parasites through cooperation with the Veterinary Molecular Biology Laboratory. Special research conducted included diseases and parasites in mule deer near game farms, diseases and parasites in elk near Yellowstone National Park, mountain lion studies, pine marten studies, and grizzly bear mortality studies. Wolf, mountain lion, and grizzly bear mortalities were recorded. Management recommendations are presented.


## INTRODUCTION

The Wildlife Laboratory has served research and management in Montana since 1955. The laboratory provides important services to wildlife biologists in Montana and conducts critical research on topics which must be investigated within a laboratory setting. Its history has been dynamic, developing with the ever-changing needs of the wildlife scientists within the state.

Wildlife laboratory activities serve many functions. The laboratory produces valuable resources used in Montana Fish, Wildlife and Parks (MFWP) information and education programs. It provides data and conducts research important to decision makers in wildlife management programs. The laboratory coordinates with other laboratories conducting similar work in neighboring states and within the state. In addition, work at

the wildlife laboratory assists law enforcement personnel during investigations of wildlife crimes.

This report summarizes the results of laboratory investigations for the period from July 1, 1993 through June 30, 1994, FY1994. The work conducted is ongoing and will continue into next fiscal year.

## JOB OBJECTIVES

1. Provide wildlife laboratory services to management and research biologists through determination of food habits, reproductive status, sex, and age of wildlife specimens submitted from throughout the state.

2. Necropsy wildlife specimens suspected of being diseased, parasitized, or dying of unknown causes to identify the probable cause of death. This includes submitting various tissue samples to appropriate laboratories for testing if warranted.

3. Coordinate and supervise the department's wildlife immobilizing drug program and conduct research on new drugs as they become available.

4. Maintain and add to reference collections of plant and animal materials.

5. Coordinate the department's wildlife/pesticide program.

6. Coordinate and maintain a central file of radio frequencies being used to mark various species of wildlife throughout the state.

7. Obtain and prepare specimens to fill requests for study skins, tanned hides, mounted specimens, skulls, and other skeletal materials to be used by department personnel and others for educational displays and programs.

8. Assist other research and management biologists in construction of various animal markers and in capture and handling of animals.

9. Conduct special physiological investigations as requested:

    a. Test serological techniques of determining pregnancy in big game animals

    b. Test ultrasonic pregnancy detection devices for reliability and validity of detecting pregnancy in live big game animals

c. Relate physiological parameters of wildlife specimens to range condition, climatological factors, population structure and size, and various management strategies in various population units in the state.

## METHODS

Food habits were determined using standard laboratory procedures: sampling, identification of food items using appropriate keys and known reference materials, volumetric measurement, and storage. Findings were returned to the original collectors for tabulation, interpretation, and final reporting.

Blood samples were obtained from big game animals during regular trapping and handling of animals for research or management purposes or from fresh hunter-killed animals. Hematology and blood chemistry measurements were done by the Livestock Department's Veterinary Diagnostic Laboratory in Bozeman.

Female reproductive tracts were prepared for examination, ovaries for sectioning, and bacula and testes for development. Uteri were examined for scars and embryonic or fetal tissue. Blood serum samples were submitted to the University of Idaho for measurement of pregnancy specific protein B levels.

Ages of ungulates were determined by tooth replacement, wear characteristics, and cementum annuli counts. Ages of bears, lions, and furbearers were determined by cementum annuli counts of sectioned teeth, skull characteristics, and/or radiographs. Radiographs were used to determine juvenile pine marten (Nagorsen et al. 1988), and adults were aged using cementum annuli counts.

Skulls of harvested mountain lions and carcasses of marten from throughout Montana were required or requested to be turned in. Skulls of bobcat trapped in Regions 2 and 3 were collected. Skulls from these animals, plus those of other lions, bears, and furbearers received in the lab, were cleaned by boiling, aged, and returned to the hunter/trapper if requested.

Various hides, capes, antlers, horns, black bear claws, skulls and elk canine teeth were collected and processed for sale at a public auction held in April 1994. A portion of these items was retained for preparation into display specimens or for educational purposes.

Bear and goat teeth were pulled, sheep and goat horns were measured, sheep horns were plugged for hunters, and furbearer pelts were tagged for trappers.

Liaison was maintained with other laboratories. Emphasis of this cooperation involved necropsy of specimens to determine cause of death and examination of wildlife for parasites and diseases. Tissues were collected to assist various genetic research

conducted in other laboratories throughout the United States. Primary labs involved are the Veterinary Diagnostic Lab and Veterinary Molecular Biology Lab, both in Bozeman. Other labs to which specimens are sent include the National Wildlife Health Research Lab in Madison, Wisconsin; the National Veterinary Services Lab in Ames, Iowa; and The National Forensics Laboratory in Ashland, Oregon.

Disease research was conducted in cooperation with the Southeast Disease Cooperative and the newly developing Western Wildlife Disease Cooperative. Program disease surviellance was conducted in cooperation with the Montana Department of Livestock (DOL) and the U.S. Department of Agriculture Animal and Plant Health Inspection Service-Veterinary Services (USDA/APHIS/VS). Specialized disease studies in mule deer near a TB-infected game farm were conducted in cooperation with the USDA/APHIS/VS, Montana State University (MSU), and Department of Livestock. Herd health summaries were conducted for bighorn sheep herds during transplant operations and special field investigations. Sample protocols were established

Statistical analysis was conducted using STATGRAPHICS software. Statistical significance indicates 95% confidence unless otherwise specified. Statistical tests used include ANOVA, Students t, or Chi-square as specified. Graphics were produced using HARVARD GRAPHICS software. Database management was conducted with DBASE III PLUS software.

## RESULTS AND DISCUSSION

### General Specimen Processing

Two hundred sixty general wildlife specimens representing 21 species were submitted to the laboratory for various processing (Table 1). General specimens include those specimens other than special trapper/hunter collections. Routine processing protocols were followed depending upon species and requests by submittors.

Hunter/trapper skulls processed this year included skulls from 413 mountain lion, 258 pine marten, 26 other furbearers, and 203 bobcat. Non-hunting specimens examined and processed include 66 mountain lion, 55 black bear, 27 bobcat, 23 bighorn sheep, 9 grizzly bear, and a variety of other species. Many of these specimens were prepared for educational materials to be distributed to wildlife educators throughout the state.

Eleven bald and 22 golden eagle carcasses were collected and data compiled from each specimen to be submitted to the USFWS. A database was created to compile annual records of eagle mortalities submitted by MFWP to USFWS. Since 1986, the MFWP laboratory has forwarded 68 golden and 42 bald eagle carcasses to USFWS.

Table 1. General specimens received and processed at the Wildlife Laboratory during FY94.

| Species | No. Processed | Percentage |
|---|---|---|
| Antelope | 1 | 0.4 |
| Bald eagle | 4 | 1.5 |
| Bighorn sheep | 43 | 16.5 |
| Black bear | 55 | 21.2 |
| Bobcat | 27 | 10.4 |
| Coyote | 2 | 0.8 |
| Elk | 1 | 0.4 |
| Fisher | 10 | 3.8 |
| Golden eagle | 5 | 1.9 |
| Grizzly bear | 9 | 3.5 |
| Lynx | 1 | 0.4 |
| Mountain lion | 66 | 25.3 |
| Mountain goat | 3 | 1.2 |
| Mule deer | 4 | 1.5 |
| Otter | 9 | 3.5 |
| Pelican | 1 | 0.4 |
| Pine marten | 4 | 1.5 |
| Swan | 1 | 0.4 |
| White-tailed deer | 1 | 0.4 |
| Wolf | 2 | 0.8 |
| Wolverine | 11 | 4.2 |
| Total | 260 | 100.0 |

**Food Habits**

Approximately 30 rumens from deer studies in the Colstrip area and Bridger Mountains were fixed and stored. Biologists from the Bridger and Colstrip studies have examined and recorded the findings in their reports. The remaining rumens are stored and awaiting identification of contents.

Over 500 grizzly bear scat samples were collected by field projects and presented for analysis during the report period. The samples were accessioned and analysis was conducted on contract by Wildlife Services, Inc. (Kevin Frey). Coordination for processing these samples was provided by the MFWP Wildlife Laboratory, and results were archived, then disseminated to various projects.

Nearly 200 stomach and colon samples from various species were examined and their contents determined. Approximately 88% of these were from marten submitted by trappers. Other samples examined include mountain lion, grizzly bear, and various furbearing species.

Fifty-five wolf scats from the Rocky Mountain East Front were measured and their contents determined. Results were sent to the biologist who submitted the samples and will be incorporated into the database for food habits of Montana wolves.

Food habits from marten collected between 1985-86 through 1991-92 were tabulated and the data summarized in preparation for publication. Results are available from 611 stomachs and 560 colons which contained food items. The data will be formatted and a summary publication produced in FY1995 or 1996.

**Nutrition**

Blood samples were obtained from 400 animals including elk, white-tailed deer, mule deer, bighorn sheep, moose, black bear, and grizzly bear. Serum biochemistries were run on these samples to determine normal background values and explore the possibility of using some of the parameters as an index to animal or herd condition. Test results were returned to the projects which submitted the samples, and one copy was retained in our files to be entered into a master computer database maintained at the laboratory. The data available in this master file will allow comparisons of herd condition between years and herd groups.

A database to compile information on blood biochemistries and hematology was updated and a data entry screen completed. The process of data entry will continue through the next year. Over 4,100 samples are recorded in the master file.

**Animal Reproduction**

Reproductive tracts were collected from various wildlife processed through the laboratory including otter, bear, lion, wolf, bobcat, fisher, and marten. Tracts are fixed and later examined to count corpora lutea and placental scars.

During the report period, 156 ovary pairs from pine marten tracts were excised and submitted to histologic sectioning by Matson's Laboratory. Results were not available for this report but will be summarized for a publication on pine marten age structure and fecundity in Montana (Appendix A).

Serum samples from deer and elk were stored and will be submitted for pregnancy determinations based on radioimmunoassay for pregnancy-specific protein B (PSPB). This technique has proven reliable in detecting pregnancy in domestic cattle and sheep as well as in free-ranging mule and white-tailed deer (Wood et al. 1986). A

complete evaluation of various techniques to determine pregnancy in live animals is proposed for FY95 including a draft of a separate report comparing ultrasound, PSPB, and assays for progesterone.

Data collected from elk fetus collections since 1948 were pooled and entered into a master database. Verification and file editing were begun. Discussion has begun regarding publication of this data. Fetal ages, mean conception, and birth dates calculated from measurements of fetuses will be compared between various elk herds and between years within some herds.

**Age Determinations**

During the report period, 828 teeth were submitted to Matson's Laboratory for counts of cementum annuli. Two hundred fifty-four marten teeth and 197 bobcat teeth were x-rayed to classify juveniles from adults. Results were filed and distributed to various programs. Ages were determined for 64 coyotes, 3 fox, and 2 badgers collected during the plague surveillance activities in Phillips County. Summaries of age structures are presented in the Bobcat and Pine Marten sections of this report. Results of cementum annuli counts were compared to other aging techniques when possible.

Tests were continued on aging of mountain lions using cementum annuli in the premolar tooth and with x-rays. Results are presented in the Mountain Lion Studies section of this report.

Data from 85 known aged grizzlies was compiled for summary analysis. A graduate student from MSU gathered the data and is working on analysis for graduate thesis credit. The analysis will compare known age and cementum ages from specimens collected during the past 30 years. Additionally, comparisons will be made between 81 samples of multiple tooth sections from the same bear but in different years to evaluate success in determining cementum rings for intervals. Sections from various teeth will be compared to detect difference in accuracy by tooth type. This analysis will be continued in 1994 to examine tooth sections from female bears with known reproductive histories. The file to date includes a potential of 20 different females from the Yellowstone (YES) and Northern Continental Divide (NCDE) Ecosystems.

**Animal Immobilizations**

Immobilizing drug needs were solicited from FWP personnel statewide. New supplies of Telazol, Ketamine Hydrochloride, and Rompun were purchased. Ketamine and Rompun were freeze dried and bottled for use in various projects throughout the state. The computer database with all drug purchases and distribution was updated during the report period. The MFWP DEA permit was renewed. Consulting was provided to MFWP personnel during various immobilization situations throughout the state. Summaries of the statewide drugging and handling form were reviewed and filed.

Additional equipment purchases were made to upgrade the laboratory tranquilizing equipment. Outdated drug stocks were incinerated.

Assistance was provided for the planning of a training program sponsored through MSU which would cover animal handling techniques. Lab personnel instructed two class sessions at an MSU techniques course on animal handling. Animal immobilization training was provided for Region 7 enforcement personnel and at a bear trapper rendezvous held at Condon, MT.

**Animal Necropsies and Tissue Examinations**

A total of 111 specimens representing 16 species of birds and mammals were examined to determine the cause of death or to identify tissues, parasites, or abnormalities. Fifty-seven necropsies were conducted, and seven tissue samples were examined by Veterinary Pathologists at the State Diagnostic Laboratory (Table 2). Six (bobcat, porcupine, coyote, bat, muskrat, and raccoon) special rabies tests and four canine parvovirus tests were also submitted. Special assays for fluoride, cyanide, strychnine, and 1080 were submitted to the MSU Chemistry Analytical Laboratory. Fifty-four necropsies were performed at the MFWP Laboratory. Necropsy reports were filed and distributed to requestors. Hair analysis, bone identification, and bone marrow compression tests were conducted on various specimens. X-ray evaluations were performed to assist necropsy and forensic examinations.

**Annual Trophy Sale**

The annual trophy sale was conducted in April. There were 180 items sold including hides, capes, skulls, claws, and antlers from ten species of mammals. Parts from bighorn sheep, black bear, and mountain lion were the most common sale items. Gross sale proceeds were $25,695. A total of 80 bidders from throughout the U.S. and Canada registered at the sale.

**Educational and Display Materials**

The wildlife mounts and reference specimens for local wildlife educational programs were available at the Wildlife Laboratory throughout the year. Specimens were checked out by educators 110 times during the report period. Several specimens were loaned to other agencies and institutions engaged in wildlife education programs.

Several educational and display materials were prepared during the year. These include two bear feet and jaw boards and plaster casts of elk and deer feet. Individual species boxes for educational loan were built for antelope, bighorn sheep, elk, deer, and moose. These boxes were added to the existing bear, furbearer, and predator educational boxes.

Table 2. Species and frequencies of wildlife specimens submitted to the State Diagnostic Laboratory for necropsy and tissue examinations during FY94.

| Necropsy Type/Species | Frequency | Percentage |
|---|---|---|
| Edible meat/tissue exams | 9 | 15.7 |
| Antelope | 2 | 3.5 |
| Mule deer | 10 | 17.5 |
| Bighorn sheep | 10 | 17.5 |
| Mountain lion | 4 | 7.0 |
| Coyote | 3 | 5.3 |
| Bobcat | 1 | 1.7 |
| Elk | 3 | 5.3 |
| Muskrat | 1 | 1.7 |
| Raccoon | 1 | 1.7 |
| Skunk | 1 | 1.7 |
| Fox | 1 | 1.7 |
| Porcupine | 1 | 1.7 |
| Magpie | 1 | 1.7 |
| Various ducks | 5 | 8.8 |
| Grizzly bear | 1 | 1.7 |
| Black bear | 4 | 7.0 |
| Total | 57 | 100.0 |

Forty-four requests for specimens from our hide and skeletal reference collections were received during the year. Twenty-eight requests were filled or partially filled. Nine tanned or green hides were distributed to various institutions, agencies, and museums throughout the U.S. In addition, 30 skulls from various mammals were distributed to requestors. Requests for jawboards, skeletons, bear claws, antlers, bird study skins, and elk teeth were also filled. Requests were filled for educational institutions such as the Grizzly Discovery Center, Museum of the Rockies, Eastern Montana College, and Zoo Montana. Claws, antler, and several whole animal carcasses were provided for undercover operations within MFWP.

**Biotelemetry Frequency Coordination**

In 1989, all known users of wildlife biotelemetry in the State of Montana provided information on wildlife transmitters they operated in various programs. The data from this census were entered into a computer database in 1990. A survey was conducted in May 1993 to update the computer database. Updates to the data were made throughout the year as information was received from projects and new frequencies were assigned. A new, thorough update is planned for July 1995.

Frequencies ranged from 148.000 to 171.000 for wildlife telemetry devices. The most commonly used range was 150.000 to 152.000 (Table 3). Approximately 1,240 of the listed telemetry devices were operating on wildlife, and 457 inoperable devices were still on wildlife through the report period. The remainder were on order, in storage, or being rebuilt. Telemetry devices operated on 20 species of wildlife (Table 4). Elk, mule deer, white-tailed deer, mountain lion, sheep, wolf, and grizzly bear were the most common species radio collared.

Table 3. Distribution of radio frequencies used on wildlife telemetry devices, 1992-93.

| Frequency Range | No. Transmitters | Percentage |
|---|---|---|
| 148.000-149.000 | 149 | 5.3 |
| 149.000-150.000 | 114 | 4.1 |
| 150.000-151.000 | 743 | 26.4 |
| 151.000-152.000 | 955 | 34.0 |
| 152.000-153.000 | 196 | 7.0 |
| 153.000-154.000 | 10 | 0.4 |
| 164.000-165.000 | 276 | 9.8 |
| 165.000-166.000 | 294 | 10.5 |
| 166.000-167.000 | 41 | 1.4 |
| 167.000-168.000 | 31 | 1.1 |
| 171.000-172.000 | 1 | 0.1 |
| Total | 2,811 | 100.0 |

Fourteen agencies or institutions have participated in the radio telemetry coordination program in 1993-94 (Table 5). Montana Fish, Wildlife and Parks was the agency most commonly employing biotelemetry in their programs.

**Parasites of Wildlife**

Trichinella tests were completed on black bears which were submitted by hunters. Under a formal agreement with Veterinary Molecular Biology, a program to test black bear harvested by hunters was initiated. A summary report from Veterinary/Molecular Biology was not available but is anticipated in FY95. During 1994, 92 black bears were tested, and 4 (4.3%) were positive for trichinella. This was much lower than the long term average of 13.1% (N=458) for 1985-1992. Collection packets were distributed to each region to facilitate the testing of black bears for this parasite. The second printing of an informational pamphlet was completed and distributed statewide through MFWP regional offices and several County Extension Service offices.

Table 4. Biotelemetry devices ordered, stored or operating on wildlife species in and near Montana, 1993-94.

| Species | No. Devices | Percentage |
|---|---|---|
| Elk | 926 | 32.9 |
| Deer (WT and MD) | 608 | 21.6 |
| Moose | 59 | 2.1 |
| Grizzly bear | 367 | 13.1 |
| Black bear | 53 | 1.9 |
| River otter | 6 | 0.2 |
| Bald eagle | 32 | 1.1 |
| Mountain goat | 8 | 0.3 |
| Bighorn sheep | 121 | 4.3 |
| Wolf | 111 | 3.9 |
| Golden eagle | 1 | 0.1 |
| Caribou | 27 | 1.0 |
| Hawk | 13 | 0.5 |
| Pine marten | 40 | 1.4 |
| Mountain lion | 129 | 4.5 |
| Antelope | 10 | 0.4 |
| Coyote | 12 | 0.4 |
| Skunk | 34 | 1.2 |
| Bull trout | 32 | 1.1 |
| Unknown or undetermined | 222 | 7.9 |
| Total | 2,811 | 100.0 |

In 1993, a parasite problem was identified in mule deer on Cromwell Island in Flathead Lake (Aune and Schladweiler 1993). Submitting mule deer pellets from the island to a Baerman test yielded dorsal spine larve of the genus *Parelaphostrongylus*. Further collections of mule and white-tailed deer fecal samples were implemented in FY1994. Samples were collected from mule and white-tailed deer in Flathead County and mule deer from Sanders, Lincoln, Powell, Gallatin, Park, and Bighorn Counties (Table 6). The distribution of this parasite appears to be predominantly in the northwest portions of the state.

Three mule deer were necropsied from Cromwell Island to search for an adult form of the parasite to identify the species. The muscle tissue was sectioned thoroughly and the meninges of the brains examined. Adult parasites were not found, and the species of parasite shedding the dorsal spine larvae has not been identified. Examinations of mule deer and white-tailed deer heads from Bighorn (N=32), Flathead (N=78), and Ravalli (N=32) Counties have failed to yield any evidence of P. *tenuis* in the meninges of the brain (Aune and Schladweiler 1992, Hood 1994).

Table 5. The number of biotelemetry devices used in various wildlife programs throughout and near the State of Montana, 1993-94.

| Wildlife Agency | No. of Devices | Percentage |
|---|---|---|
| The Blackfoot Nation | 28 | 1.0 |
| Confederated Salish Kootenai | 1 | 0.1 |
| Bureau of Land Management | 14 | 0.5 |
| U. S. Forest Service* | 1 | 0.1 |
| Montana Fish Wildlife and Parks | 1,690 | 60.1 |
| U.S. Fish and Wildlife Service | 197 | 7.0 |
| Glacier National Park | 18 | 0.6 |
| Idaho Fish and Game | 44 | 1.6 |
| Interagency Grizzly Study | 149 | 5.3 |
| Montana State University | 114 | 4.1 |
| University of Montana | 373 | 13.3 |
| Wildlife Wildlands Institute | 3 | 0.1 |
| Wildlife Research Institute | 71 | 2.5 |
| Yellowstone National Park | 75 | 2.7 |
| Other or Unknown | 31 | 1.1 |
| Total | 2,811 | 100.0 |

* Includes radio frequency for hand radios.

Several cases of parasitism were diagnosed in wildlife during the year. A porcupine with pinworm and tapeworm infestation was necropsied. *Taenia hydatigena* cysticerci were found in mule deer from Park, Gallatin, and Madison County. Eimeria and Trichostrongyle ova were detected in an antelope from Park County. A severe case of lungworm was detected in an elk calf near Roundup, Montana. The parasite was identified as *Dictyocaulis hadweni*. Capillaria spp. was found in ducks at Wildlife Rehab Center in Flathead County. *Capillaria hepatica* was found in one muskrat from Flathead County. Bladder worms were identified in mule deer from Gallatin and Bighorn Counties. Lungworms were found in fecal samples of mule deer submitted to Baerman tests (Table 7).

Table 6. *Paraelaphostrongylus* larvae detected in deer fecal samples using the Baerman technique, 1993-94.

| County | Location | Species | No. Sampled | No. Positive | % Positive |
|---|---|---|---|---|---|
| Lake | Cromwell Island | Mule Deer | 25 | 21 | 84.0 |
| Flathead | Stillwater River | Whitetail | 15 | 6 | 40.0 |
| Sanders | Cougar Peak | Mule Deer | 12 | 10 | 83.3 |
| Lincoln | Tenmile Cr. Horse Range | Mule Deer | 10 | 9 | 90.0 |
| Powell | Blackfoot Clearwater WMA | Mule Deer | 11 | 0 | 0.00 |
| Gallatin | Bridger Mtns. | Mule Deer | 23 | 0 | 0.00 |
| Park | N. Gardiner | Mule Deer | 8 | 0 | 0.00 |
| Bighorn | N. Hardin | Mule Deer<br>Whitetail | 67<br>3 | 0<br>0 | 0.00<br>0.00 |

Table 7. Lungworm counts in mule deer fecal samples submitted to Baerman tests.

| County | Location | No. Sampled | No. Positive | % Positive |
|---|---|---|---|---|
| Gallatin | Bridger | 23 | 8 | 34.0 |
| Bighorn* | N. of Hardin | 67 | 12 | 17.9 |

* Reported by Hood (1994)

**Diseases of Wildlife**

Blood serum samples from several species of wildlife were tested at the Veterinary Diagnostic Laboratory for the presence of antigen/antibodies against various diseases. Most samples were routinely tested for anaplasmosis, bluetongue, *Brucella abortus*, and eight serovars of leptospirosis. Additional diseases tested for in some samples included infectious bovine rhinotracheitis (IBR), bovine virus diarrhea (BVD), parainfluenza 3 ($PI_3$), *Brucella ovis*, *B. canis*, ovine progressive pneumonia (OPP), canine distemper, canine parvovirus, Lyme disease, plague, tularemia, and toxoplasmosis. Results from these additional tests will provide baseline data for comparison with data collected in subsequent years.

A computer database was updated with entries from serological surveys conducted throughout the state. The database now includes over 7,000 records from many species including deer, sheep, elk, moose, bison, bear, wolf, coyote, lion, and others. Annual file editing and clean-up is complete. Detailed analysis is continuing as time permits and needs arise. The data will be updated annually allowing further analysis of serological survey results.

Serum which remains after routine serologic tests and large animal profiles are completed is banked at the laboratory. Several requests for use of this resource were filled. Serum from several species of wildlife from different parts of Montana was submitted to the U.S. Department of Agriculture researchers who have developed a test for malignant catarrhal fever (MCF) to test for antibodies to this disease.

Hemorrhagic Disease Survey

The Wildlife Lab coordinates Montana's participation in the annual nationwide hemorrhagic disease surveillance conducted by the Southeastern Cooperative Wildlife Disease Study. Questionnaires were sent to 55 field biologists and wardens located in areas where hemorrhagic disease might be expected to occur, and 36 (65%) were returned. Two responses offered anecdotal information (second-hand reports of dead deer) that could have been related to hemorrhagic disease, but also could have had any of a wide variety of causes. Lacking any definite or substantiated reports, it was determined that no hemorrhagic disease occurred in Montana in 1993.

Plague and Distemper Surveillance

Because of their potential to cause severe negative impacts to black-footed ferrets or their major prey (prairie dogs), disease surveillance is a vital factor to consider in efforts to reintroduce ferrets to Montana (Schladweiler and Stoneburg 1993). Diseases of major concern are canine distemper, which is generally fatal to ferrets, and plague, which causes mortality approaching 100% in prairie dogs and may also cause direct mortality of ferrets. Surveillance efforts also include tularemia, toxoplasmosis, and five serovars of leptospirosis.

Blood samples were obtained from 30 coyotes and 2 red fox in south Phillips County, and 34 coyotes, 2 badgers, and 1 fox on the Fort Belknap Indian Reservation in February 1994. Methods of taking and handling these animals were essentially the same as reported previously (Schladweiler and Stoneburg 1993).

Results of serologic testing for the presence of disease antibodies will be only briefly presented here. This and other data from these collections will be combined with similar information from other collection periods and reported in a comprehensive manner at a later date.

Some serum samples were of questionable quality or of insufficient quantity to perform some of the serologic tests. Among south Phillips County coyotes, 67% tested positive for plague, 45% were distemper positive, and 17, 11, and 3% were positive for exposure to toxoplasmosis, tularemia, and leptospirosis, respectively. Both foxes from this area showed positive plague titers with one also being positive for distemper and the other testing positive for tularemia exposure. Both lacked antibodies to leptospirosis and toxoplasmosis.

Fort Belknap coyotes showed 39, 12, 6, and 3% with positive titers for distemper, plague, toxoplasmosis, and leptospirosis exposure, respectively. All were negative for tularemia exposure. One badger tested positive for distemper and tularemia while showing no titers for any of the diseases tested for. The single fox from this area showed a positive distemper titer.

Tuberculosis Surveillance

Tuberculosis was diagnosed in six Montana game farms during the 1990-1994 period. Three of these game farms were small and voluntarily depopulated the infected herds. The remaining three were of larger size and went through herd test and slaughter procedures implemented by the Montana Department of Livestock. During this period, a TB surveillance program for wildlife was implemented by MFWP in the areas surrounding Corwin Springs in 1991-1993 (Aune and Schladweiler 1993) and near Hardin, Montana, in 1993-94.

Results from the survey in 1991-1993 near Corwin Springs are being prepared in a final paper to be presented to the Journal of Wildlife Diseases (Appendix B). Preliminary summaries are presented in Aune and Schladweiler (1993) and Meyer et al. (1993).

Additional surviellance during FY94 was conducted through an MSU graduate project supported by the Rocky Mountain Elk Foundation. During Fall 1993 and Winter 1994, tissue, blood, and fecal samples were collected from game ranched animals in a TB infected game ranch and free-ranging wildlife from outside the game ranch. In October and November 1993, two white-tailed deer and eight mule deer were sampled through hunter collections (Hood 1994). A special collection of 30 mule deer and 1 white-tailed deer took place in December 1993.

As a result of this study, one TB infected free ranging mule deer was confirmed (Rhyan et al. 1994). An abstract of a published paper reporting this incident in the Journal of Wildlife Diseases is presented in Appendix C. Hood (1994) summarized other disease and parasite information discovered during this project. Additional surveillance and monitoring of tuberculosis is anticipated for FY95.

Bighorn Sheep Health Summary

Results of the bighorn sheep health evaluations during transplant operations on Wildhorse Island are presented in Appendix D.

A herd health summary for bighorn sheep in hunting district 340 was started. Blood samples and throat cultures were collected from 25 sheep captured during field research in March 1994 near Melrose Montana (Table 8). Blood serum from 24 sheep were tested for antibodies/antigens for various diseases. Throat cultures were positive for mixed pathogens in 15 sheep, and pasteurella isolates were retained from 10 sheep. The isolates were submitted to the National Animal Disease Research Center in Ames, Iowa. Four of the samples were not *Pasteurella haemolytica* and most likely were another species of *Pasteuralla*. Six samples were bio and sero typed. All six were bio type T with a mix of serotypes 3, 4, 10, and 15. Parasites in this bighorn sheep population are being investigated by Hoar (1994). Lungworm was prevalent in the sheep examined during 1992 and 1993. A complete health summary will be completed in FY1995.

Ten bighorn sheep were examined from various parts of Montana to determine the cause of death (Table 9). Three cases of Bronchopneumonia were identified. Various parasite problems were also noted.

Tendoy Mountains Sheep Die-off

In the fall and early winter of 1993, bighorn sheep in the Tendoy Mountains south of Dillon, Montana, began to suffer from pneumonia. Investigations into the cause of the enzootic involved collection of two ewe sheep and necropsy of four fresh carcasses. The results of the disease investigations indicated that the sheep died as a result of combinations of parasitic, bacterial, and viral agents (Table 10). The bacteria pasteurella commonly involved in sheep pneumonia was isolated in only one of the specimens examined. It is estimated that 60-70% of the Tendoy sheep herd died from the pneumonia complex.

Table 8. Serologic evidence of various disease from bighorn sheep captured near Melrose, 1994.

| Serologic Test | No. Pos/No. Neg | Percent Pos. |
|---|---|---|
| Brucella abortus | 0/24 | 0.0 |
| Blue Tongue | 0/24 | 0.0 |
| Anaplasmosis | 0/24 (5 Suspect) | 0.0 |
| Brucella ovis | 0/24 | 0.0 |
| Infectious Bovine Rhinotracheitis | 0/24 | 0.0 |
| Bovine Viral Diarrhea | 11/13 | 45.8 |
| Para-Influenza | 22/2 | 91.7 |
| Ovine Progressive Pneumonia | 0/24 | 0.0 |
| Leptospira pomona | 0/24 | 0.0 |
| Leptospira hardjo | 0/24 | 0.0 |
| Leptospira grippotyphosa | 0/24 | 0.0 |
| Leptospira autumnalis | 0/24 | 0.0 |
| Leptospira icterohemorrhagia | 0/24 | 0.0 |
| Leptospira canicola | 0/24 | 0.0 |
| Leptospira bratislava | 0/24 | 0.0 |
| Leptospira tarassovi | 3/21 | 12.5 |

Table 9. Necropsy results from bighorn sheep found dead during FY94.

| Case No. | Sex | County | Parasites | Cause of Death | Bacteriology/ Virology |
|---|---|---|---|---|---|
| 8-46 | M | Ravalli | Trichostrongyls<br>Nematodirus<br>Eimeria<br>Trichuris | Bronchopneumonia/ Endoparasites | Streptococcus/ BVD |
| 8-47 | F | Ravalli | Moniezia<br>Nematodirus | Bronchopneumonia/ Pasteurellosis | P. hemolytica |
| 8-197 | F | Park | | Fractures/Blunt Trauma | None |
| 8-208 | M | Madison | | Management Control | None |
| 8-216 | M | Phillips | | Bronchopneumonia/ Mild Parasitism | Staphylococcus |
| 8-228 | F | Ravalli | Marshallagia<br>Protostrongylus | Unknown/Mild Parasitism | Acinetobacter calcoaceticus |
| 8-229 | M | Ravalli | Marshallagia<br>Protostrongylus | Possible Trauma/Mild Parasitism | Streptococcus |
| 8-269 | F | Missoula | Marshallagia | Trauma | Streptococcus |
| 8-315 | M | Beaverhead | Protostrongylus<br>Marshallagia<br>Nematodirus | Malnutrition ? | |
| 8-318 | M | Ravalli | Marshallagia | Cellulitis/Bacteremia | E. coli |

Table 10. Summary of bacteriology and histopathology from bighorn sheep necropsied during an enzootic of pneumonia complex in the Tendoy Mountains, 1993.

| Case | Lungworm* | Bacterial Isolate | Virus | Other Parasites | Morphologic Diagnosis |
|---|---|---|---|---|---|
| 8-149 | Positive | Streptococcus | IBR | Yes | Verminous Pneumonia |
| 8-150 | Possible | Streptococcus Actinomyces | Neg. | Yes | Broncho-Pneumonia |
| 8-151 | Possible | Actinomyces | IBR | No Test | Purulent Pneumonia |
| 8-152 | No Test | Actinomyces | Neg. | No Test | Cellulitis |
| 8-159 | No Test | Pasteurella | IBR | No Test | Pasteurella Pneumonia |
| 8-202 | Positive | Staphylococcus Streptococcus | BVD | Yes | Fibrinous-Purulent Pneumonia |

* Possible denotes nematode larvae were observed in lung tissue during histopathologic examination, however, lungworms were not detected in fecal matter.

Other diseases or abnormalities were noted during the year. A uterine carcinoma was diagnosed in one porcupine. Various forms of pneumonia were diagnosed in antelope, raccoon, and mule deer.

Several species of waterfowl were examined from a wildlife rehabilitation center specializing in waterfowl. The cause of the deaths was avian tuberculosis. The facility had a enclosed rehab area and shared water sources throughout the facility including a fenced area that wild birds frequently entered.

## Grizzly and Black Bear Studies

### Morphology Study

Two databases were created to examine the morphology of grizzly and black bears in Montana in 1991. The mortality database includes all deaths and results from examination of bear carcasses. This database was updated with records from over 726 black bears and 1,036 grizzly bears. The black bear capture database includes data from over 900 black bears handled during research throughout Montana. The grizzly bear capture database includes records of 297 grizzly bears handled in the northwestern portion of Montana.

Measurements of grizzly bear skeletons collected over 30 years is complete. The information is going through format conversions and will be analyzed in the near future as time permits. Collection and measurement of skulls will also be continued as time allows. Results were not summarized as expected. The project will continue as time permits.

### Nuisance Bear and Relocation Study

In the Northern Continental Divide and Yellowstone Ecosystems, records of relocations were compiled from capture forms provided by field personnel. A database was created to record all problem incidents in Montana at the laboratory. To accurately measure annual variation in these activities, several definitions were developed. A relocation included movements within a bear home range as well as far outside. However, movements within home ranges (short distance) are not indicated in table 11. A problem case was the situation leading to control actions. Relocations include each individual relocation (e.g. if mother and cubs are split up, the relocations are independent). A problem incident is a reported situation which demands attention or is a significant interaction between bear and humans, property, or livestock.

In the NCDE during 1994, four bears were relocated as a result of two problem incidents. One incident involved three grizzly bear cubs from the Mission Mountains that were captured and retained in a rehabilitation center before being placed in winter dens.

Comparisons of the last five years shows a significant amount of variation in these activities from year to year (Table 11). These variations are probably a result of short-term environmental changes which can be natural or human caused (e.g. drought, food failures, corn spills, etc.). A significant amount of relocation activity occurs both east and west of the Continental Divide. A complete analysis of the success of relocation efforts in the NCDE is presented by Riley et al. 1995.

Table 11. Updated summary of grizzly bear relocations in the Northern Continental Divide Ecosystem during 1988-1994.

| Year | No. Bears | No. Cases/ Relocs. | Sex Ratio | No. Killed That Year | No. on East/West |
|---|---|---|---|---|---|
| 1988 | 3 | 3/3 | 1M/2F | 1 | 3E/0W |
| 1989 | 15 | 10/12 | 6M/9F | 2 | 6E/4W |
| 1990 | 9 | 9/9 | 3M/6F | 1 | 3E/6W |
| 1991 | 12 | 13/14 | 8M/4F | 2 | 8E/5W |
| 1992 | 9 | 8/9 | 3M/6F | 2 | 1E/7W |
| 1993 | 3 | 3/3 | 2M/1F | 1 | 1E/2W |
| 1994 | 4 | 2/2 | 4M/ | 1 | 0E/2W |
| Total | 55 | 48/52 | 27M/28F | 10 | 22E/26W |

Records from the Animal Plant and Health Inspection Service, Animal Damage Control Division (APHIS/ADC) are filed at the laboratory annually. A statewide summary of APHIS/ADC grizzly bear control activities from 1967-1994 was conducted to determine trends in these activities (Fig. 1). The number of control actions varied from year to year. However, trend lines indicate that the actions have been stable to slightly increasing for this time period. Control kills have been reduced in recent years because many bears were relocated rather than destroyed. A notable decline in control actions is evident for the early 1970s until 1975. The number of livestock conflicts with grizzly bears has risen since the early 1970s.

## Grizzly Mortality Study

A master database was updated for all known grizzly bear mortalities for the Northern Continental Divide Ecosystem. Data in the files are being verified at this time for more complete summarization at a later date. Results presented below may be modified slightly to correct errors identified in the validation process. Grizzly mortalities in the Yellowstone Ecosystem were updated back to 1959 and are all validated through comparison with previous efforts by Craighead et al. (1988) and Knight et al. (1993 and 1994).

For the period 1967-1993, a total of 496 grizzly bear deaths or live removals were recorded in the NCDE. The data were summarized by region in a test of the information base. In MFWP Regions 1, 2, and 4, a total of 370, 28, and 108 mortalities, respectively, have occurred. Mortality has varied annually but has been

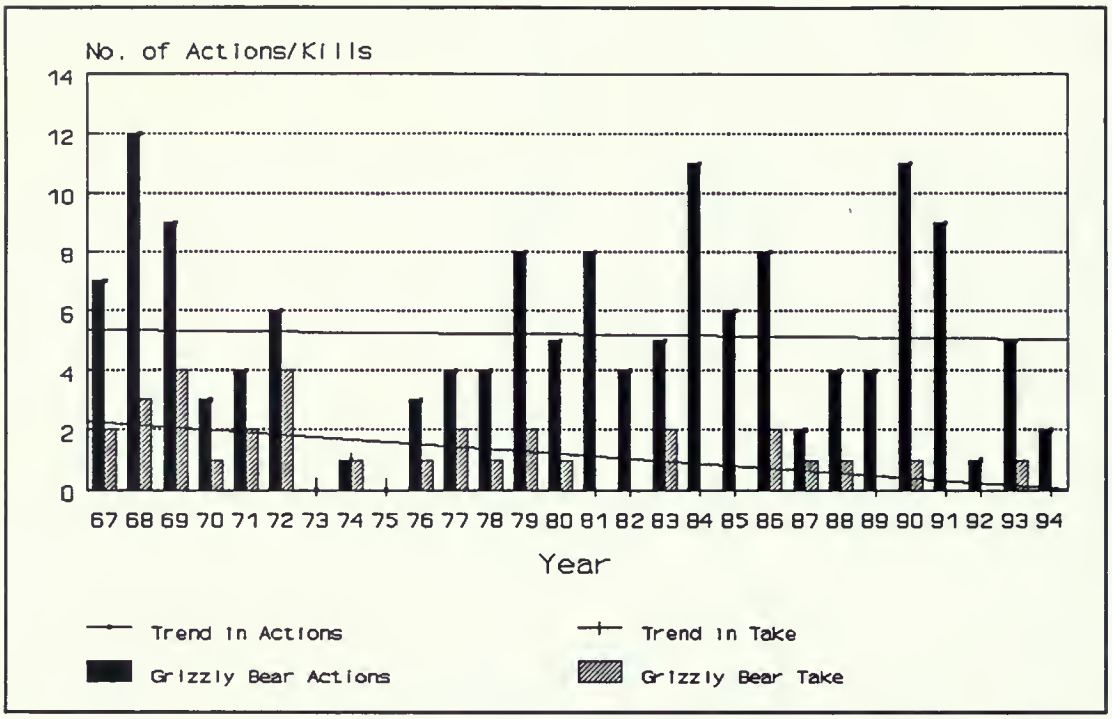


Figure 1. APHIS/ADC animal damage control activities in Montana, 1967-94

generally declining (Fig. 2). The sex ratio of the pooled mortalities or live removals is 45.5% female and 54.5% male. There were more males than females removed from the population in all regions (Fig. 3). Region 4 had the largest proportion of males removed.

For the period 1959-1993, a total of 527 known grizzly bear deaths or live removals were recorded in the Yellowstone Ecosystem. Population loss varied annually but has generally been declining (Fig. 2). The sex ratio for all mortalities or removals is 42.2% female and 57.8% male. There were 130 and 8 grizzly bears (26.7% of total) removed from the populations from Regions 3 and 5 within the administrative jurisdictions of MFWP. About one third of the grizzlies removed from the ecosystem (37.1%, N=195) came from within the boundaries of Yellowstone National Park. There were 194 grizzlies (36.8%) removed from National Forests and private land in the states of Wyoming and Idaho.

When comparing the number of mortalities in each month for the NCDE and YES, there are some observable differences (Fig. 4). In the YES, there was a higher incidence of mortality grouped into the summer months. In the NCDE, most of the mortality occurred during the fall when annual hunting seasons were held until 1990.

The distribution of ages for grizzly bears killed in the NCDE and YES differed slightly (Fig. 5). There were more young aged bears (2-6) killed in the NCDE while

more cubs were removed from the Yellowstone Ecosystem for this time period. Seventy-five percent of the cub mortality in the Yellowstone Ecosystem occurred prior to 1972.

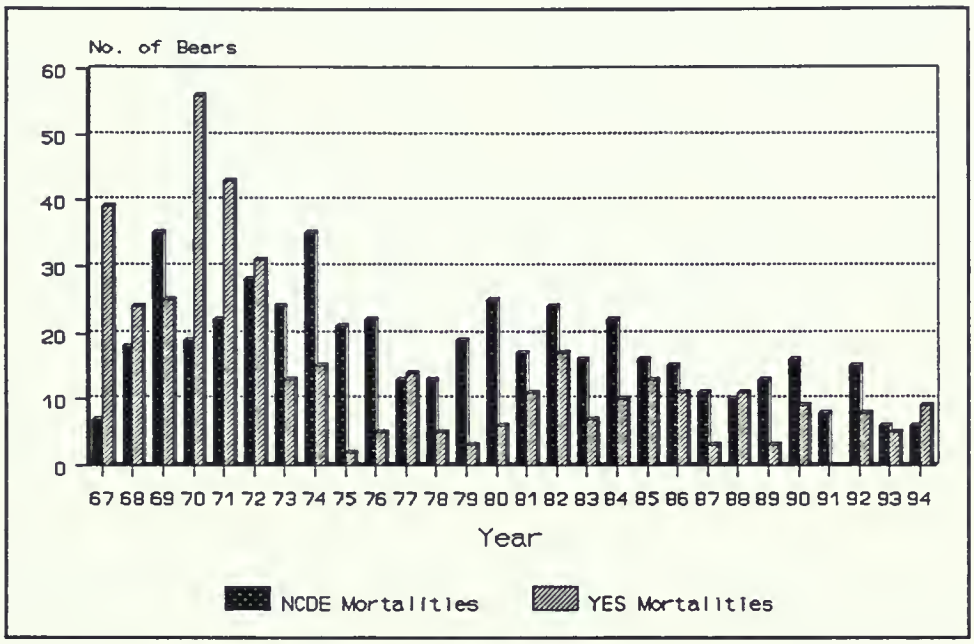


Figure 2. The number of grizzly mortalities by year for the NCDE and YES, 1967-1994.

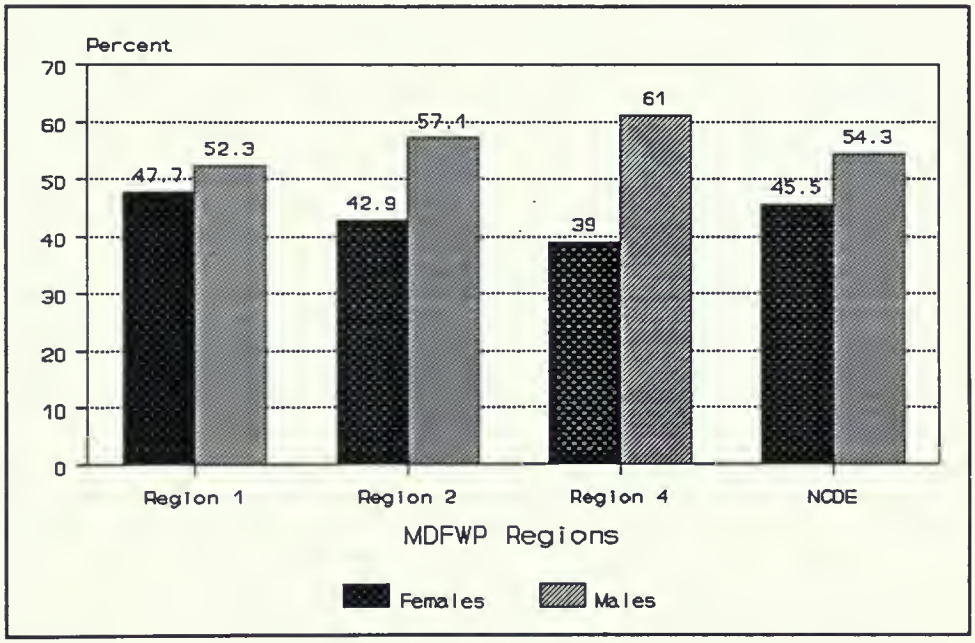


Figure 3. Grizzly bear mortalities by MFWP Region for the NCDE, 1967-1994.

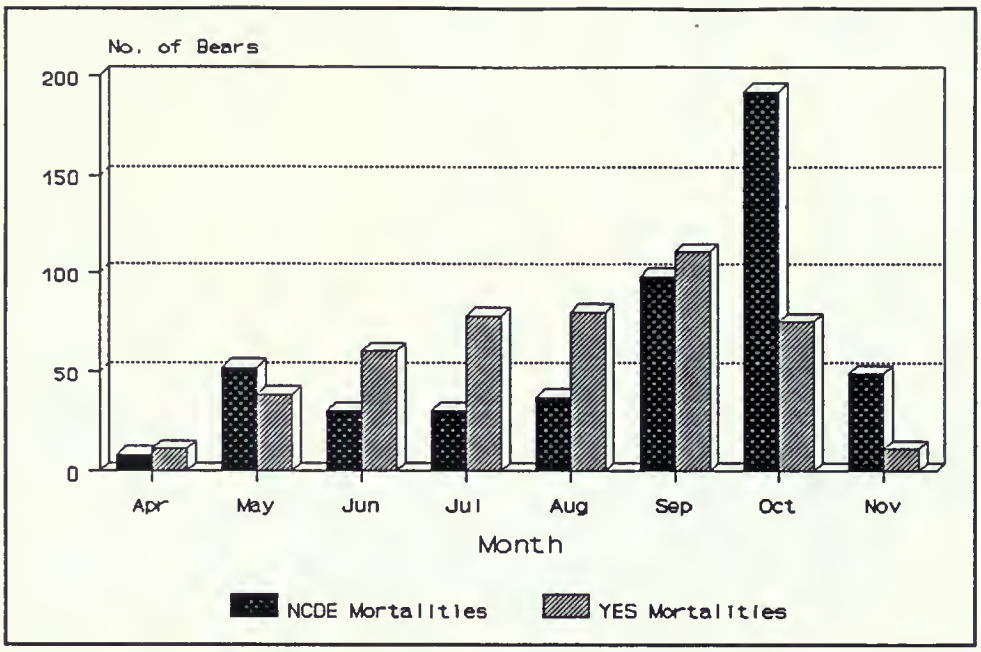


Figure 4. Grizzly mortalities by month for the NCDE and YES, 1967-94.

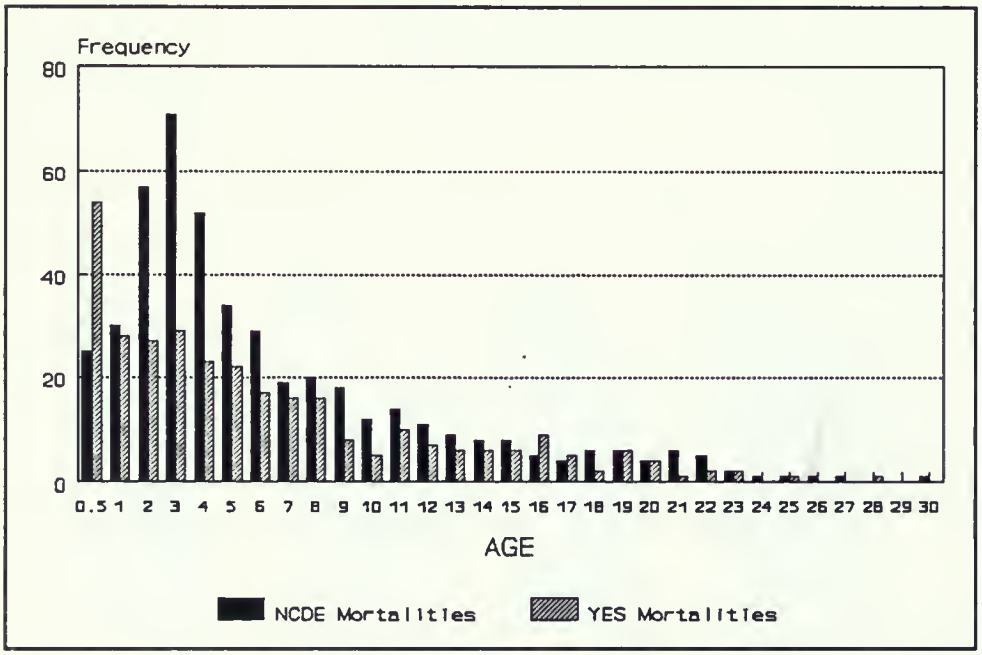


Figure 5. Ages of grizzly bears killed in the NCDE and YES, 1967-94.

## Black Bear Mortality Studies

During the period 1986-1994, the annual non-hunting mortality for black bears was recorded. Non-hunting mortalities include illegally taken bears, road kills, animal damage control, and nuisance bears. These records do not represent all non-hunting mortalities, but those for which a hide, skull, or carcass was submitted to the laboratory. During 1986-94, the annual non-hunting loss of black bears reported at the laboratory has ranged from 20 to 64 (Fig. 6). In more recent years, there has been an increased attempt to account for the non-hunting mortalities within the state. Further work is progressing on the detailing of non-hunting mortality in Montana. Detailed report forms and accurate regional accounting of black bear mortalities statewide are recommended in the future.

Black bear animal damage control activities vary annually (Fig. 7). Recent years indicate that there has been an increased level of activity directed toward black bears by APHIS/ADC. Most of these problems have been related to sheep depredations and beehive damage.

Non-hunting black bear mortality occurs between the months of March and December (Fig. 8). Statewide, the majority of non-hunting mortalities occur during the spring and fall months. September was the month with the highest percentage of non-hunting black bear mortalities.

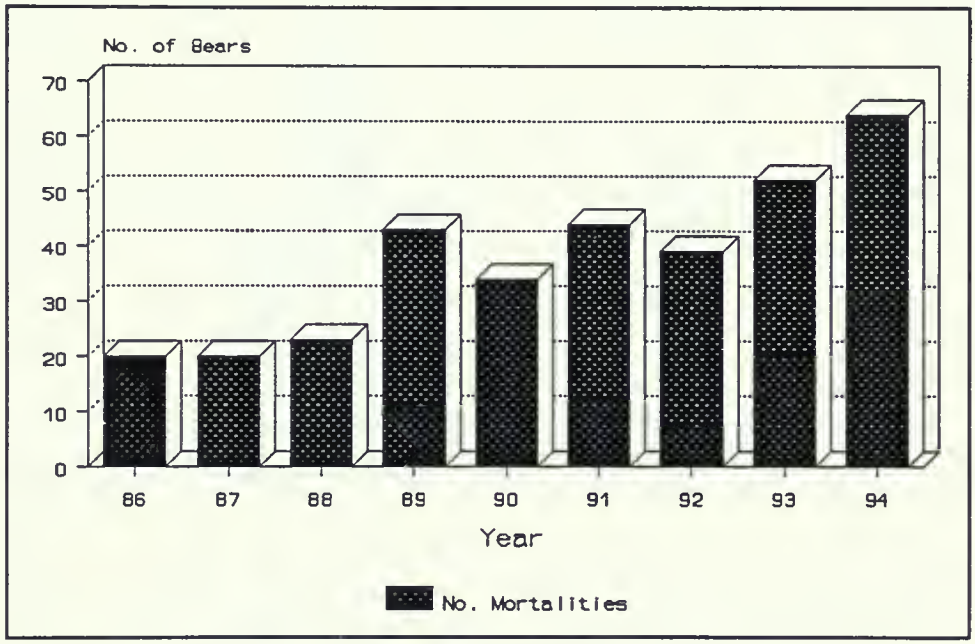


Figure 6. Non-hunting black bear mortalities in Montana, 1986-94.

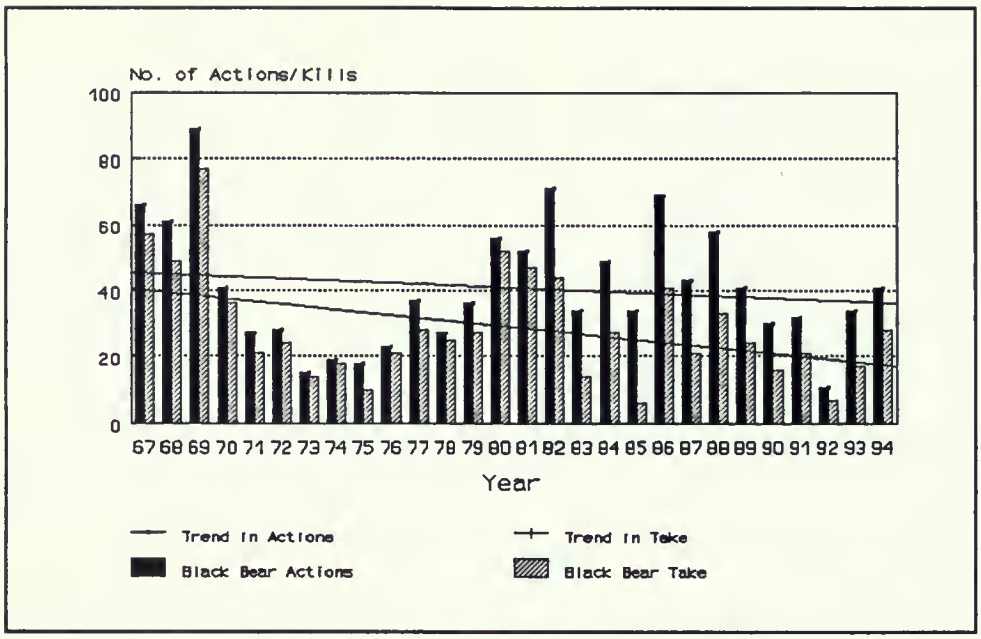


Figure 7. APHIS/ADC black bear depredation actions in Montana, 1967-94.

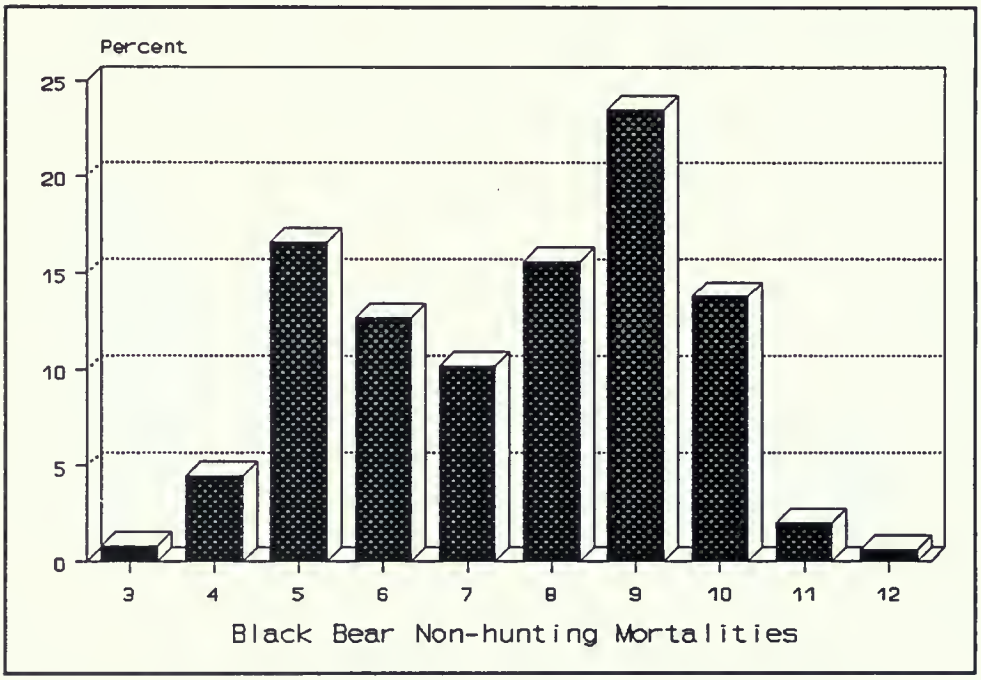


Figure 8. Non-hunting black bear mortalities by month, 1966-94

The age structure of black bears involved in non-hunting mortalities is skewed toward subadult bears (Fig. 9). Non-hunting mortality is predominantly occurring in Regions 1, 2, and 3 (Fig. 10). The larger number of non-hunting mortalities in Region 3 may be an artifact of the close proximity to the MFWP laboratory and better record keeping. Further analysis of these data are expected as the black bear mortality database is refined and edited.

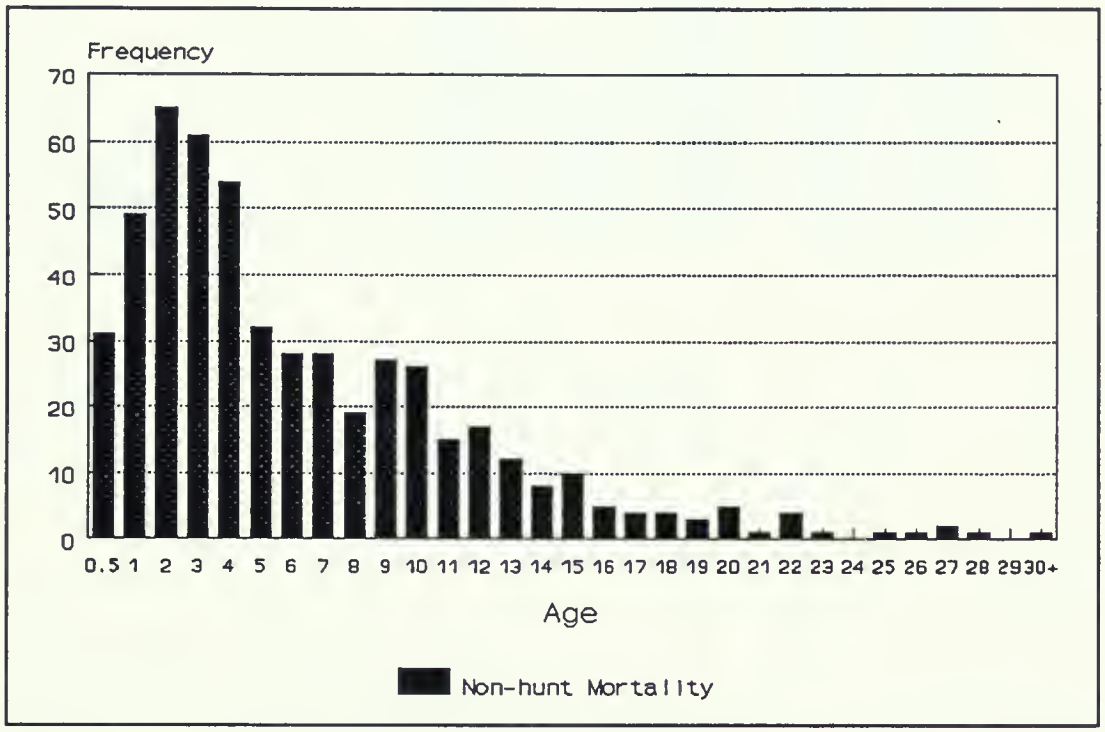


Figure 9. The age distribution of non-hunting black bear mortalities in Montana 1986-1994.

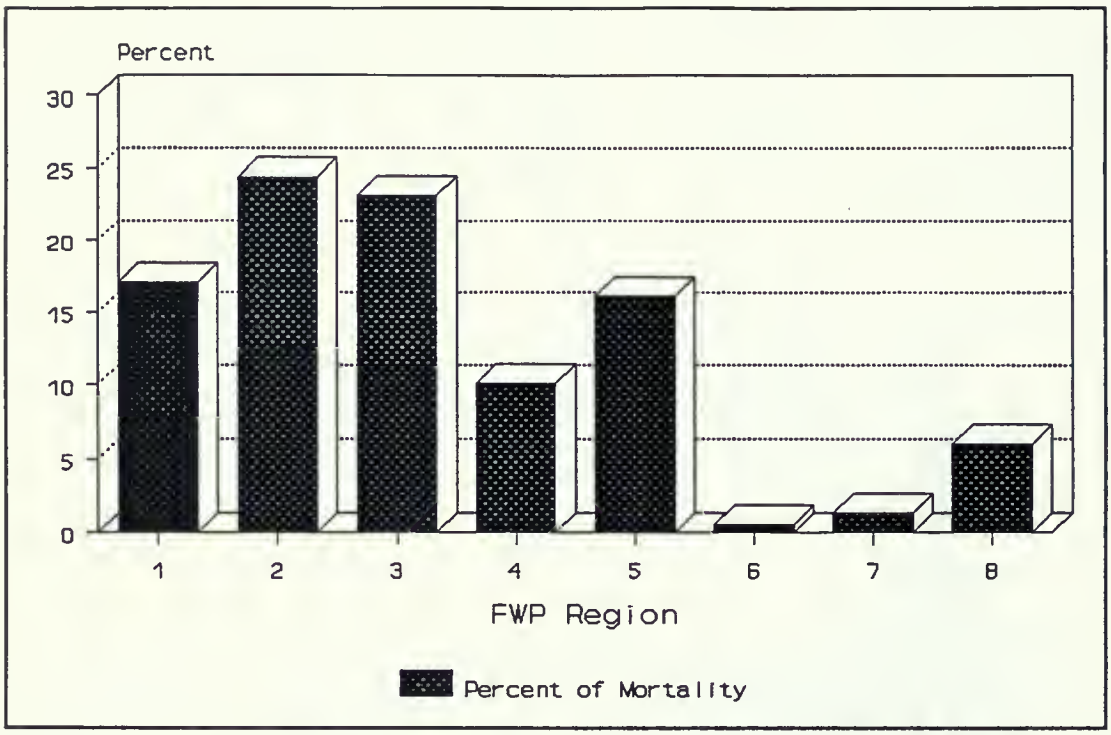


Figure 10. The distribution of non-hunting black bear mortalities by administrative region, 1986-1994.

## Disposition of 1994 Grizzly Bear Carcasses

The number of known grizzly bear mortalities in 1994 was 10 for the YES and 6 for the NCDE. Three carcasses or skeletal remains were recovered by the Wyoming Fish and Game. Three grizzly bears were removed and transferred to zoos. One mortality in the YES included a marked yearling for which no carcass or parts were recovered. Animal parts were recovered and delivered to MFWP from nine specimens during the year. Final disposition for these specimens has not been determined.

Parts of three specimens from the Yellowstone Ecosystem were examined. Two whole carcasses were necropsied but hides were not salvageable. Only the skull was provided for examination for the third specimen. Skulls from all three specimens were retained in the MFWP collection awaiting final disposition.

In the NCDE, parts from six specimens were examined. Only skull and bones were available for one specimen. Only the hide and skull were collected from two specimens. Three whole carcasses were examined. Two hides were salvageable from the six specimens. Six skulls were retained in the MFWP collection awaiting final disposition.

Final disposition for 1993 specimens included three frozen hides returned to Glacier National Park and two hides returned to the Blackfeet Nation. One salt dried grizzly hide was provided each to the USFS and to Wyoming Game and Fish for educational purposes. One skull each was provided to the Grizzly Discovery Center and the USFWS. Two skulls were returned to the Blackfeet Nation. Claws were provided to the MFWP enforcement program.

## Gallatin Black Bear Study

In 1994, a spring photo-survey was conducted in two areas including the Turner Properties' Flying D Ranch and on a portion of the Gallatin Forest between Bozeman and Swan Creek. The study area south of Bozeman represents a forested black bear habitat with high human disturbance and roading. The Flying D Ranch is a 132,698-acre ranch adjacent to the Spanish Peaks Wilderness with habitat similar to the area south of Bozeman but with lowered human impacts and roading. The hunting pressure between these two areas is expected to be different.

Six camera stations were placed along two transects across each study area. The stations were run from 10-20 days during June and early July. An individual bear included single bears or family groups. Family groups were counted as a single bear unit because cubs are unable to act independently.

Eight individual bears were identified from photographs on the Flying D Ranch. There were 14 individual bears identified in the camera census for the area south of Bozeman. Other animals detected included moose, elk, white-tailed deer, mule deer, coyote, bobcat, pine marten, and various birds. There were fewer elk, but slightly more moose detected in the area south of Bozeman when compared to the Flying D Ranch. The percentage of black bear photographs taken was lower while the percentage of errors increased. There were 22 individual bear detections in an area encompassing approximately 650 square miles. Assuming a bear density of 5 $mi^2$/bear, the survey identified 22 of 130 bears or 16.9%.

The detection rate (camera nights/individual bear) in 1994 was 11.2 and 9.3 for the Flying D Turner Properties and the South Bozeman study units respectively. Black bear were detected in all stations except two on the Flying D Ranch (Tables 12 and 13). The photographs of black bears accounted for 24.5 and 20.4% of the total photographs taken. Black bear detection rate for June-July 1994 was similar to the detection rate for June 1992 on the Flying D Ranch and for the area south of Bozeman in 1992 and 1993 (Fig. 11).

Table 12. Results from photo-census efforts on the Turner Ranch, June 1994.

| Site | Camera Nights | Total Photos | Bear | Elk | Deer | Moose | Errors | Test | Ind. Bears |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 22 | 63 | 35 | 0 | 2 | 2 | 0 | 24 | 3 |
| 2 | 10 | 183 | 23 | 0 | 1 | 3 | 121 | 35 | 1 |
| 3 | 19 | 50 | 0 | 25 | 0 | 3 | 3 | 19 | 0 |
| 4 | 21 | 68 | 38 | 0 | 2 | 0 | 1 | 27 | 3 |
| 5 | 7 | 125 | 9 | 0 | 0 | 0 | 99 | 17 | 1 |
| 6 | 10 | 24 | 0 | 3 | 3 | 0 | 1 | 11 | 0 |
| Total | 89 | 513 | 105 | 28 | 14 | 8 | 225 | 133 | 8 |
| % | | | 20.4 | 5.5 | 2.7 | 1.6 | 43.9 | 25.9 | |

Table 13. Results from photo-census efforts on the Gallatin National Forest, June-July 1994.

| Site | Camera Nights | Total Photos | Bear | Elk | Deer | Moose | Errors | Test | Ind. Bears |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 27 | 56 | 15 | 0 | 0 | 4 | 4 | 26 | 1 |
| 2 | 26 | 151 | 75 | 0 | 3 | 1 | 27 | 44 | 4 |
| 3 | 16 | 75 | 2 | 0 | 5 | 0 | 39 | 25 | 1 |
| 4 | 18 | 88 | 43 | 0 | 0 | 0 | 3 | 41 | 2 |
| 5 | 29 | 77 | 13 | 0 | 2 | 9 | 0 | 53 | 4 |
| 6 | 14 | 180 | 6 | 0 | 2 | 2 | 114 | 43 | 2 |
| Total | 130 | 627 | 154 | 0 | 12 | 23 | 187 | 232 | 14 |
| % | | | 35.8 | 0.0 | 1.9 | 3.6 | 29.8 | 37.0 | |

In both 1994 sessions, a small accessible bait ball with a dose of tetracycline was offered at each camera site. Bears visiting the site could consume the bait ball, and the photographs would offer verification. Tetracycline consumed orally has been applied as a biomarker in wildlife studies (Van Brackle et al. 1994, Taylor and Lee 1994). During the 1994 camera sessions, nine individual bears consumed the tetracycline bait. There was the potential to biomark 22 individual bears. Black bears often refused the bait laced with tetracycline even though many types of attractive baits were used to hide the tetracycline. During Fall 1994, teeth will be collected from all harvested bears in the

area where black bears were biomarked. Histologic sections of teeth will be viewed under a florescent microscope to identify marked bears.

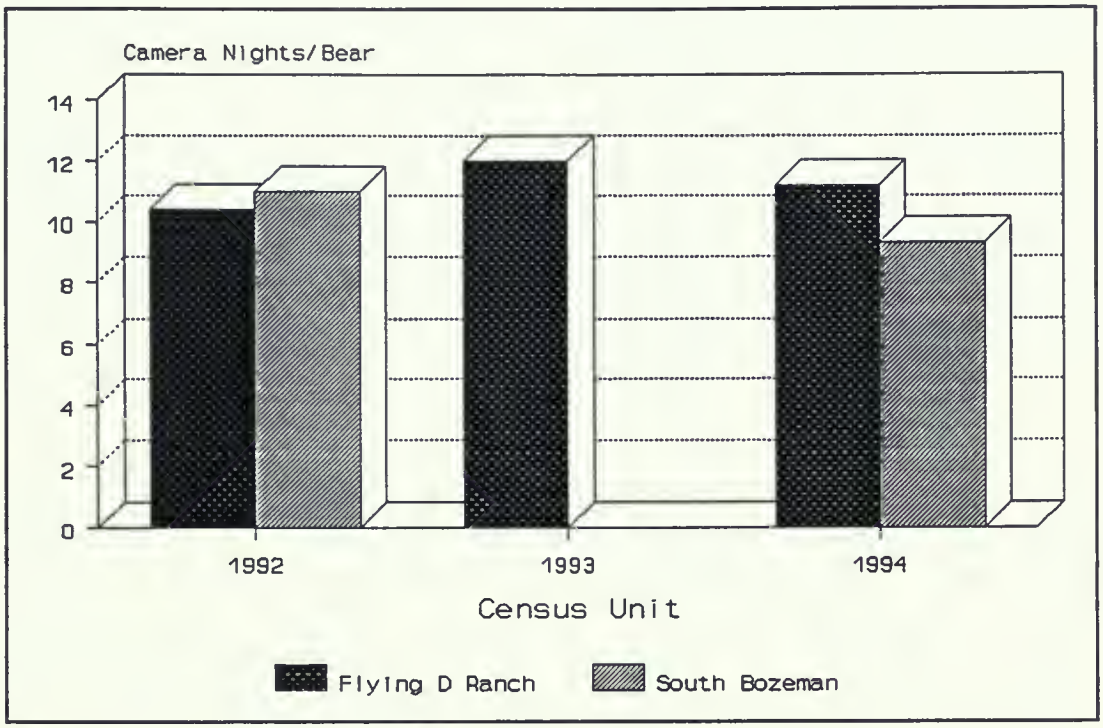


Figure 11. Camera nights per individual bear detection in two study areas 1992-1994.

Preliminary evidence suggests that detection rate by camera-survey techniques may be a useful method in monitoring relative abundance and evaluating distributions of black bear populations. Detailed techniques and analytical methods need to be developed before such systems can be applied broadly to other areas or species.

Mountain Lion Studies

Montana mountain lions were studied by examination of previous laboratory records, 64 whole or partial carcasses, and over 450 skulls from hunter-killed lions. A standard laboratory protocol was established for each lion skull and carcass examined. From each skull, the age and sex were determined. The physical characteristics from each carcass were measured, reproductive tracts and fetuses collected, the stomach contents analyzed, and general condition indices developed. Many diseased or parasitized lions were examined to quantify the extent of these conditions.

## Mountain Lion Morphology Study

Skulls from hunter killed mountain lions were measured. Analysis was not completed by the time of this report. The reader is referred to previous laboratory reports for review of the previous efforts in this area of study.

Physical measurements and weights are taken from each specimen processed in the Wildlife Lab. Analysis is pending. The final analysis of preliminary data is awaiting the final age determinations of each specimen using multiple age techniques. It is paramount to these types of data analysis that age be accurately determined before analysis. We anticipate a complete summary of the physical characteristics of Montana mountain lion in the next annual report.

## Mountain Lion Food Habits

Stomach contents were examined from 56 mountain lions and results are reported in Aune and Schladweiler (1993). Contents from additional stomachs were collected in 1993-94. Contents from lion stomachs involved in livestock or human conflicts were examined. Results are presented in the section on human/lion interaction in this report. Results from the remaining lion stomachs are pending. Analysis to this date indicate that lions ate a varied diet consisting of elk, white-tailed deer, mule deer, moose, small mammals, and other. The number one food item for lions was white-tailed deer followed by elk and mule deer. Detailed analysis is being deferred until further collections have been made.

## Mountain Lion Reproduction

Since 1989, over 130 female reproductive tracts have been collected and fixed for detailed examination at a later date. Work is now progressing on these specimens. In addition, efforts have been made to collect fetuses from all pregnant female lions. These fetuses are weighed and measured to develop a fetal growth chart which will help in defining conception dates for pregnant lions collected in the future. Eighteen fetuses have been collected, and fourteen were measured from five litters of lions. An average of 3.6 fetuses were found in the reproductive tracts of these lions. Fetuses grew from a weight of less than 1 gram to a birth weight of over 500 grams. Further work is planned for detailing the reproductive activity of mountain lions from carcass collections and results will be presented at a later date.

## Testing Cementum Aging Techniques in Mountain Lions

### Tests for Consistency in Cementum Counts

To evaluate the consistency of premolar cementum aging techniques, we conducted two tests. The first determined if changes have occurred in evaluation over

long periods of time, and the second looked at two blind reviews of the same histologic sections of mountain lion premolars from within the same year of collection.

A sample of 102 tooth sections originally aged in 1988-89 was resubmitted for aging. The second age evaluations were then compared to the first (Fig. 10). The distribution and mean ages determined from each of these submissions indicates that cementum ages have increased at least one year due to differences in interpretation of cementum annuli. The error was at least as great as one year. This suggests that age differences from one year to the next of less than one year may not be meaningful.

In 1993-94, lion teeth were submitted for cementum aging. From the total sample of 356 teeth, a subsample of 102 teeth were examined twice in a blind test. Comparing the results from these two readings indicates that age analysis for each reading were similar (Fig. 12).

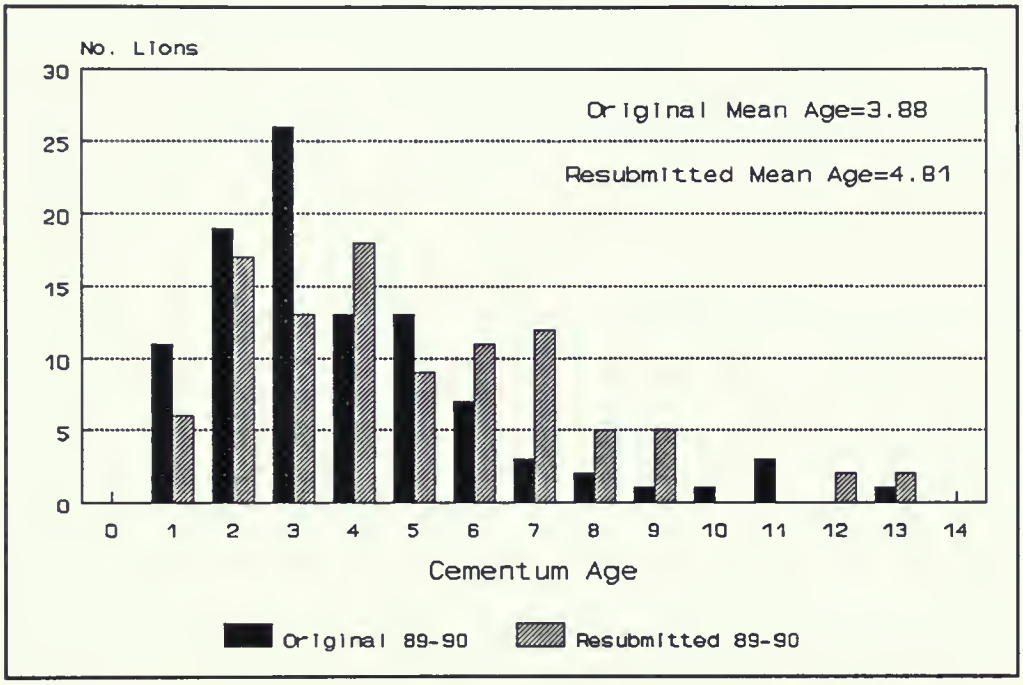


Figure 12. Comparison of two readings for 1988-89 mountain lions.

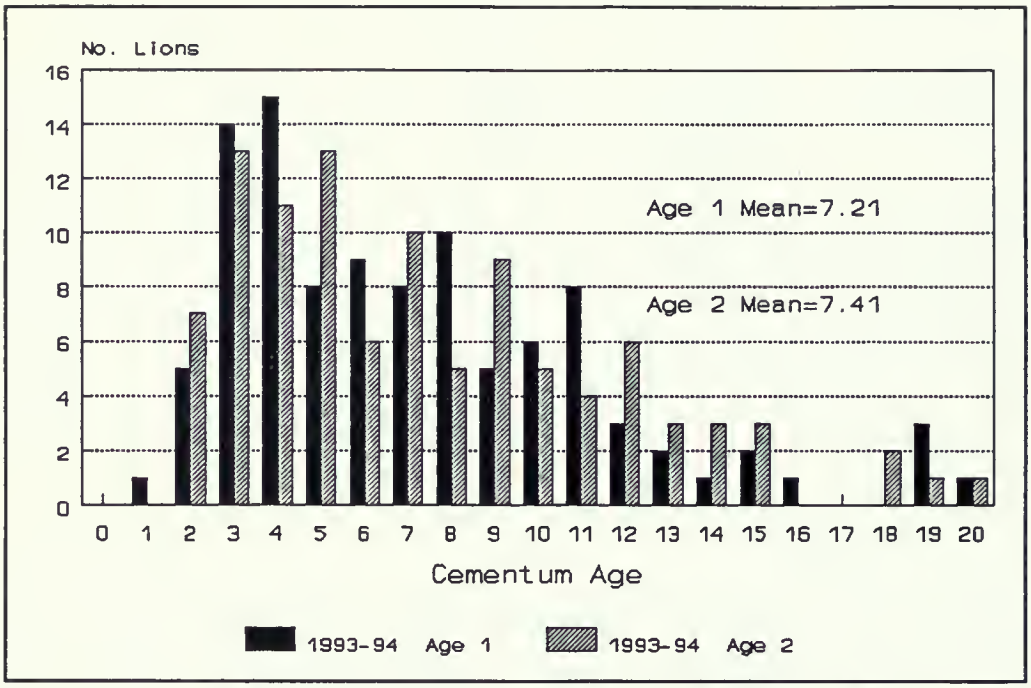


Figure 13. Comparison of two independent cementum age determinations for 1993-94.

Comparisons of X-Ray and Suture Analysis with Cementum Analysis

A comparison of age techniques for lions killed in 1992-93 and 1993-94 was initiated. A total of 744 lions were aged using cementum analysis and also classified by the proportion of pulp cavity in the upper canine tooth. We also examined 420 of these lions to evaluate suture closure (Greer Unpublished). Criteria for classifying lion kittens based on x-ray of pulp cavities were established from a sample of 17 lions of known age or with canines that were two thirds or less erupted. Criteria for classifying yearling kittens was established from a sample of 71 lions of known age or with canines that were greater than two thirds erupted but not fully erupted.

Lions x-rayed were classified as kitten (up to 12 months), yearling (13-24 months), two-year-old (25-36 months), and older than 3 years by comparing the proportion of pulp cavity to canine tooth diameter. Table 12 shows the results from x-ray analysis of known aged or reliably aged lions. Kittens 8-12 months old had canines that were permanent but not fully dropped (Power 1988, Ashman and Greer 1976) and pulp cavity to tooth diameter ratios greater than 65% (N=17). The apical foramen of the canine tooth was widely open. Yearling lions had canines greater than two thirds to just fully erupted, pulp cavity ratios of 41-65%, and were class I lions based on suture analysis (N=71). The apical foramen of the canine was closing but remained open. Two year old lions had full canines with little staining, and the canine pulp ratios were

20-40% (N=4). The apical foramen is closed or nearly closed. Two year old known aged lions were suture class II. Three year and older lions had yellow stained canines with some wear evident and had pulp cavity ratios less than 20% (N=1). These lions were suture class III or greater.

Cementum counts of the premolar teeth of lions aged kitten and yearling were higher than expected (Table 14). From the 17 skulls with dental characteristics consistent with kittens, the cementum counts ranged from 0 to 4. The kittens with permanent canines but less than two thirds dropped presented at least one cementum ring on histologic sections. Kittens with a pulp cavity ratio less than 70% were all aged 2 to 4 years old; however, the canines were only two thirds erupted indicating a maximum age of about 12 months (Ashman and Greer 1976).

Lions with upper canines more than two thirds erupted but with the cementum enamel junction still absent are 12-24 months (Anderson 1983). Of 71 lion skulls with canines not fully erupted but greater than two thirds erupted, the cementum counts ranged from 1 to 5. Of four known-aged lions between 13-24 months, the cementum counts ranged from 2 to 4. These lions were primarily suture class I and occasionally class II. Cementum counts of the premolar teeth of lions aged yearling were also higher than expected.

An insufficient number of known aged lions 2 years old and greater were available for detailed analysis, but preliminary examination of a small number of known aged lions (Table 14) indicates that 2 year olds may have pulp cavity ratios between 20 and 40%. Preliminary criteria were used to differentiate 2 year olds from older lions for the 1992-93 and 1993-94 data.

A comparison of the data from each age technique shows that cementum counts vary greatly from x-ray analysis for the yearling and two year old class lions (Fig. 14). The variance in two year old lions is greatest. However, the criteria for establishing 2 year old lions using x-ray are weak at this time. The data from one year old lions is of great concern. The number of 1 year old lions established by cementum counts varied greatly from those established as age 1 through x-ray analysis.

Table 14. Comparison of the tooth characteristics of known aged lions and reliably aged kittens using cementum annuli counts, pulp cavity ratios and suture class determinations.

| Lab No. | Known Age | Suture Class | Canine | Percent Pulp Cavity | Cementum Annuli | Sex |
|---|---|---|---|---|---|---|
| 180435 | 4-6 mo. | KI | Temp. | | 0A | M |
| 180373 | 6-8 mo. | KI | Temp. | | 0A | M |
| 180380 | 6-8 mo. | KI | Temp. | | 0A | F |
| 180229 | 6-8 mo. | KI | Temp. | | - | M |
| 180219 | 6-8 mo. | KI | Temp. | | 0A | M |
| 180411 | 6-8 mo. | KI | Temp. | | - | M |
| 180413 | 6-8 mo. | KI | Temp. | | - | F |
| 5660 | 8-10 mo. | KI | 1/4 drop | | 0A | M |
| 180462 | 8-10 mo. | KI | 1/4 drop | 86.7 | 0B | ? |
| 5688 | 8-10 mo. | KI | 1/4 drop | 80.0 | 1B | M |
| 6336 | 8-10 mo. | KI | 1/4 drop | 76.7 | 0A | M |
| 1803 | 8-10 mo. | KI | 1/3 drop | 80.0 | 1A | M |
| 180848 | 8-10 mo. | KI | 1/2 drop | | 1A | ? |
| 180879 | 10-12 mo. | I | 1/2 drop | 76.9 | 1A | F |
| 5130 | 10-12 mo. | I | 2/3 drop | 76.0 | 2A | F |
| 5711 | 10-12 mo. | I | 2/3 drop | 71.4 | 2B | M |
| 5444 | 10-12 mo. | I | 2/3 drop | 71.4 | 1A | M |
| 180296 | 10-12 mo. | I | 2/3 drop | 76.9 | 1A | ? |
| 180463 | 10-12 mo | I | 2/3 drop | 62.5 | - | F |
| 180464 | 10-12 mo. | I | 2/3 drop | 64.7 | 1B | F |
| 180299 | 10-12 mo. | I | 2/3 drop | 66.6 | 2B | F |
| 180301 | 10-12 mo. | I | 2/3 drop | 64.3 | 4A | M |
| 180539 | 10-12 mo. | I | 2/3 drop | 64.7 | 2A | F |
| 180589 | 10-12 mo. | I | 2/3 drop | 69.2 | 2A | F |
| 180842 | 10-12 mo. | I | 2/3 drop | 64.7 | 2A | M |
| 180699 | 10-12 mo. | I | 2/3 drop | 66.7 | 2B | M |
| 4320 | 10-12 mo. | I | | | 3A | M |
| 3862 | 10-12 mo. | I | | | 3B | M |
| 180456 | 10-12 mo. | I | | | 3B | M |
| 180352 | 17 mo. | I | 2/3 drop | 53.3 | 4A | F |
| 180370 | 17-18 mo. | I | Full Drop | 50.0 | - | F |
| 4651 | 18 mo. | II | Full Drop | | 2B | M |

| Lab No. | Known Age | Suture Class | Canine | Percent Pulp Cavity | Cementum Annuli | Sex |
|---|---|---|---|---|---|---|
| 180384 | 19 mo. | II | Full Drop | 42.9 | 3A | M |
| 6702 | 30 mo. | II | Full Drop | 35.3 | 6B | M |
| 5592 | 30 mo. | II | Full Drop | 27.8 | 11A | M |
| 6704 | 30 mo. | II | Full Drop | 23.5 | 11B | M |
| 3348 | 3 yr. | III | Yellow | | 7B | M |
| 3353 | 6 yr. | VI | Yellow | | 8B | F |
| 4182 | 7-8 yr. | VII | Yellow | | 5B | F |

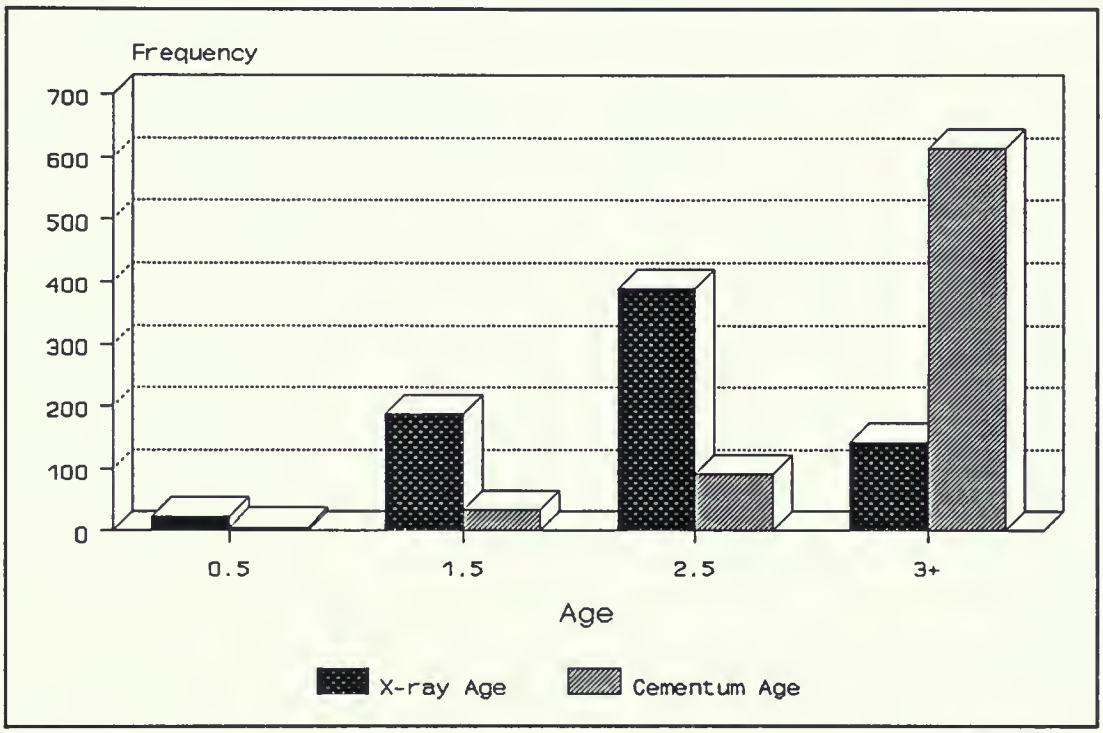


Figure 14. Comparisons between age groups determined by x-ray and cementum analysis 1992 and 1993.

## 1993-94 Mountain Lion Harvest Age and Sex Structure

The number of mountain lions harvested in Montana has risen steadily from 164 in 1988-89 to 477 in 1993-94 (Table 15). The number of recorded non-hunting mortalities increased from 5 in 1988-89 to 64 in 1993-94. Self-defense cases, animal damage control, and nuisance lions added significantly to the number of nonhunting mortalities. A significant increase in the hunting mortalities occurred during 1990-94 (Fig. 15). Regions 1, 3, and 4 reported significantly higher numbers of lions harvested during 1993-94 as compared to the previous year (Table 16). Regions 1 and 2 accounted for 61.8-69.9% of the harvest during the period 1988-93. In 1993-94, their portion declined to 53.7%.

Table 15. Lion mortalities by mortality class, 1988-89 through 1993-94.

| | No. of Lions * | | | | | |
|---|---|---|---|---|---|---|
| Mortality Class | 1988-89 | 1989-90 | 1990-91 | 1991-92 | 1992-93 | 1993-94 |
| Accidental Snare | 2 | 3 | 1 | 2 | 4 | 2 |
| Animal Damage Control | 0 | 4 | 7 | 7 | 8 | 11 |
| Nuisance Control | 0 | 1 | 6 | 4 | 9 | 4 |
| Human Threat | 0 | 2 | 2 | 0 | 1 | 0 |
| Illegal | 0 | 2 | 1 | 3 | 4 | 6 |
| Dogs | 2 | 0 | 0 | 0 | 1 | 1 |
| Road Kill | 1 | 4 | 2 | 10 | 7 | 16 |
| Self Defense | 0 | 5 | 5 | 4 | 7 | 4 |
| Train | 0 | 1 | 1 | 0 | 0 | 1 |
| Natural | 0 | 2 | 5 | 6 | 5 | 2 |
| Unknown | 0 | 1 | 1 | 8 | 2 | 15 |
| Wounding | 0 | 0 | 0 | 1 | 0 | 0 |
| Trapping | 0 | 0 | 0 | 0 | 0 | 2 |
| Subtotal | 5 | 25 | 31 | 45 | 48 | 64 |
| Hunting | | | | | | |
| Archery | 30 | 38 | 44 | 49 | 66 | 74 |
| Handgun | 69 | 71 | 94 | 84 | 45 | 151 |
| Rifle | 60 | 57 | 87 | 100 | 42 | 185 |
| Unknown | 0 | 2 | 3 | 4 | 3 | 3 |
| Subtotal | 159 | 168 | 228 | 237 | 56 | 413 |
| TOTAL | 164 | 193 | 259 | 282 | 404 | 477 |

* This is an updated version of results for these four years. Some changes have been made in data from previous years.

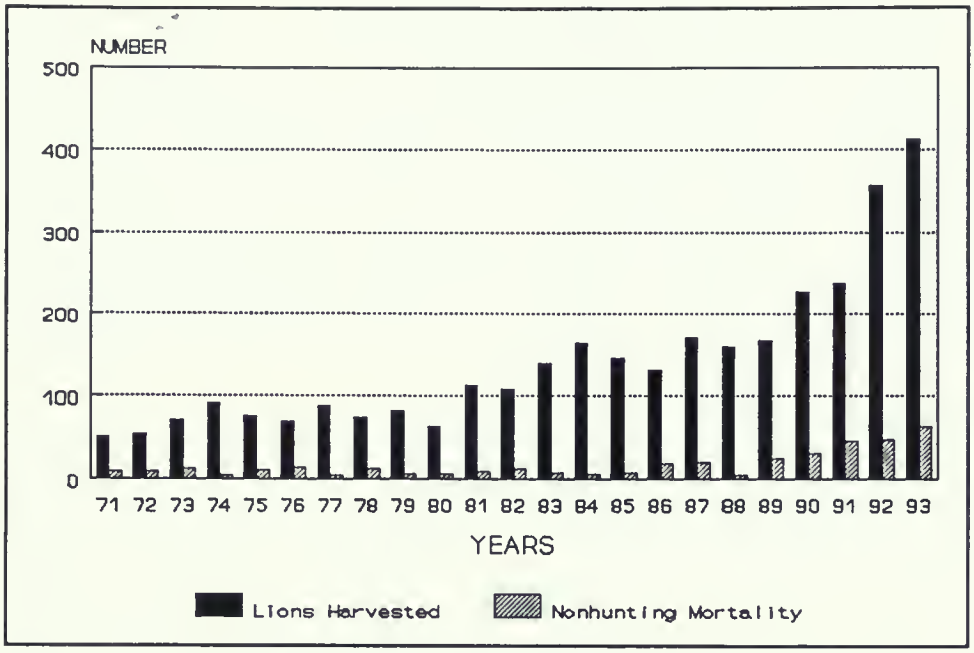


Figure 15. Mountain lion mortality trend, 1971-93.

Table 16. Lion mortalities by MFWP Regions, 1988-89 to 1993-94.

| Region | 1989-90 | | 1990-91 | | 1991-92 | | 1992-93 | | 1993-94 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Hunt | Nonhunt | Hunt | Nonhunt | Hunt | Nonhunt | Hunt | Nonhunt | Hunt | Nonhunt |
| 1 | 66 | 9 | 84 | 15 | 109 | 19 | 117 | 26 | 139 | 20 |
| 2 | 50 | 9 | 64 | 6 | 56 | 12 | 117 | 3 | 117 | 23 |
| 3 | 18 | 2 | 27 | 3 | 22 | 5 | 29 | 12 | 51 | 15 |
| 4 | 21 | 3 | 30 | 4 | 30 | 3 | 44 | 4 | 63 | 3 |
| 5 | 12 | 3 | 21 | 4 | 20 | 6 | 43 | 3 | 35 | 3 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 5 | 0 |
| 7 | 1 | 0 | 1 | 0 | 0 | 0 | 3 | 0 | 3 | 0 |
| 8 | | | | | | | (15) | (4) | (12) | (0) |

() Number of lions killed in Region 8 are integrated into respective Regions 3 and 4 to compare with administrative boundaries of previous years.

Harvest Age Structure Derived from Cementum Age

Hunting mortalities were 159, 168, 228, 237, 356, and 413 in 1988-89 through 1993-94, respectively. The mountain lion harvest has increased significantly and steadily from 50 lions in 1970-71 to over 477 in 1993-94 (Fig. 15). The harvest increase correlates with increased license sales and harvest quotas during this period (Fig. 16). The proportion of females in the harvest has slowly increased over this time period (Table 17). Harvest statistics were summarized for each hunting district in Montana (Table 18). Many districts showed significant increases in lion harvest over the six-year period.

The age distribution of the statewide harvest has shifted upward steadily for the past five years, then shifted leftward in 1993-94 (Fig. 17). The mean age of mountain lions in the harvest increased significantly ($P<0.05$) from 1988-89 to 1992-93, then declined in 1993-94 to 5.8 (Fig. 18). The median age rose from 3 to 7, then declined to 4 in 1993-94. There was no difference in the mean age of lions between regions for each of the four annual hunting seasons compared ($P<0.05$). Mean age increased through 1992-93, then declined in 1993-94 in all regions (Fig. 19). The mean age of both males and females appears to have followed a similar pattern (Fig. 20).

The values obtained for the ages of harvested lions may be inaccurate due to ageing technique. Trainer and Matson (1988) have demonstrated that premolar aging can be conducted consistently. However, as stated above, the accuracy is unknown. Readers should be warned that the actual values demonstrated in this data set may not be accurate, but trends across years probably reflect true tendencies in the age structure.

Harvest Age Structure Derived from X-ray Analysis

The number of one year old and two year old lions in the harvest was similar when comparing the harvest in 1992-93 to 1993-94 based on x-ray analysis (Fig. 21). The percentage of yearlings identified in x-rays was 28.3% in 1992 and 21.1% in 1993. These data do not support a significant leftward shift in age structure depicted using cementum counts of the premolar teeth.

Human/Lion Interactions

During the period from July 1989 until August 1994, interactions between mountain lions and humans were monitored. Records of interactions were compiled from regional newspaper articles, MFWP written case reports, USFWS Disposition Reports, and necropsy reports from the MFWP Wildlife Laboratory. A total of 191 incidents confirmed by wildlife officials were recorded. These reports did not include incidental sightings near homes or communities. Other reports were received by phone or written correspondence but could not be confirmed by official reports.

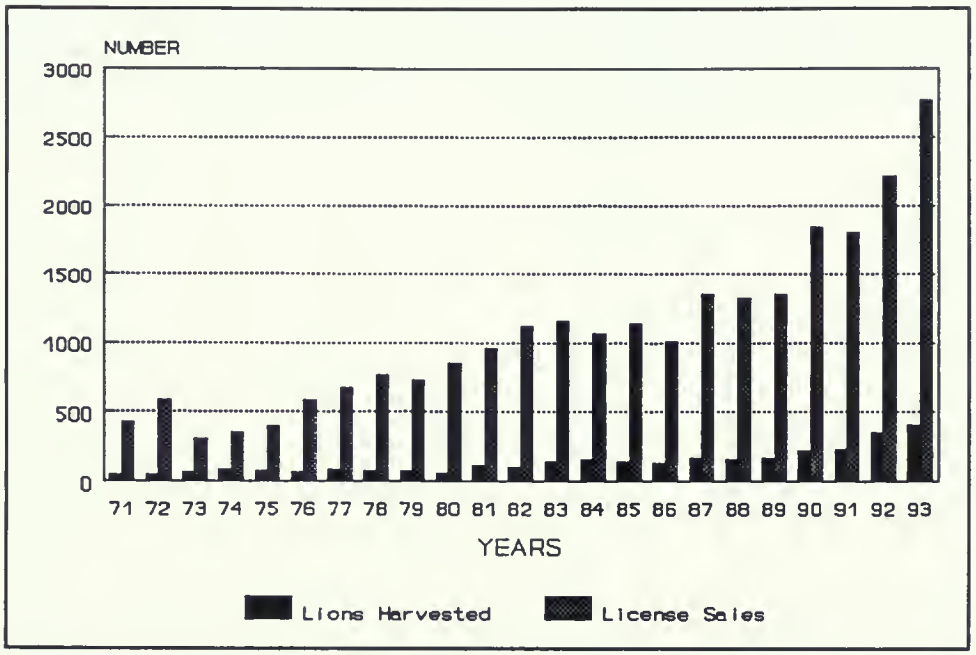

Figure 16. Lion harvest and license sales from 1971-72 through 1993-94.

Table 17. Sex ratios of harvested mountain lions, 1990-1993.

| Sex | Number | | | | Percent | | | |
|---|---|---|---|---|---|---|---|---|
| | 1990 91 | 1991 92 | 1992-93 | 1993 94 | 1990 91 | 1991 92 | 1992-93 | 1993 94 |
| Males | 154 | 153 | 237 | 269 | 67.0 | 64.6 | 66.6 | 65.5 |
| Female | 73 | 84 | 119 | 142 | 32.2 | 35.4 | 33.4 | 34.5 |

Table 18. Mountain lion harvest by hunting districts, 1988-89 through 1993-94.

| Hunting Dist. | 1988-89 | 1989-90 | 1990-91 | 1991-92 | 1992-93 | 1993-94 | Total |
|---|---|---|---|---|---|---|---|
| 100 | 5 | 11 | 12 | 14 | 17 | 21 | 80 |
| 101 | 4 | 6 | 7 | 8 | 13 | 11 | 49 |
| 102 | 1 | 4 | 4 | 7 | 7 | 11 | 34 |
| 103 | 9 | 1 | 6 | 12 | 8 | 8 | 44 |
| 104 | 0 | 0 | 2 | 0 | 2 | 2 | 6 |
| 110 | 3 | 6 | 6 | 8 | 12 | 10 | 45 |
| 120 | 1 | 4 | 4 | 2 | 3 | 2 | 16 |
| 121 | 9 | 10 | 12 | 13 | 12 | 23 | 79 |
| 122 | 1 | 5 | 5 | 10 | 10 | 5 | 36 |
| 123 | 5 | 6 | 7 | 12 | 5 | 9 | 44 |
| 124 | 0 | 0 | 0 | 0 | 3 | 2 | 5 |
| 130 | 9 | 10 | 9 | 11 | 9 | 16 | 64 |
| 132 | 0 | 0 | 4 | 10 | 7 | 8 | 29 |
| 140 | 2 | 1 | 5 | 1 | 8 | 9 | 26 |
| 141 | 0 | 1 | 1 | 1 | 0 | 0 | 3 |
| 150 | 1 | 0 | 1 | 0 | 1 | 2 | 3 |
| 170 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 200 | 1 | 1 | 3 | 1 | 4 | 4 | 10 |
| 201 | 4 | 6 | 6 | 3 | 5 | 11 | 24 |
| 202 | 7 | 10 | 6 | 5 | 12 | 8 | 40 |
| 203 | 6 | 1 | 4 | 7 | 5 | 4 | 23 |
| 204 | 0 | 5 | 4 | 6 | 11 | 10 | 26 |
| 205 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 210 | 3 | 2 | 4 | 3 | 2 | 7 | 14 |
| 211 | 0 | 0 | 0 | 0 | 1 | 2 | 1 |
| 212 | 2 | 0 | 3 | 2 | 3 | 3 | 10 |
| 213 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 214 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 215 | 0 | 1 | 0 | 1 | 2 | 2 | 4 |
| 216 | 2 | 2 | 2 | 3 | 5 | 2 | 14 |
| 231 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 240 | 6 | 2 | 8 | 1 | 16 | 15 | 33 |
| 250 | 7 | 8 | 10 | 6 | 10 | 11 | 41 |
| 260 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 261 | 0 | 0 | 1 | 1 | 1 | 3 | 3 |
| 270 | 1 | 1 | 1 | 0 | 7 | 3 | 10 |
| 281 | 2 | 3 | 3 | 4 | 8 | 6 | 20 |
| 283 | 3 | 2 | 4 | 3 | 8 | 10 | 20 |
| 285 | 2 | 1 | 1 | 3 | 5 | 7 | 12 |
| 290 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| 291 | 1 | 1 | 1 | 1 | 3 | 2 | 7 |
| 292 | 1 | 2 | 1 | 2 | 3 | 2 | 9 |
| 293 | 2 | 2 | 1 | 2 | 4 | 3 | 11 |

| Hunting Dist. | 1988-89 | 1989-90 | 1990-91 | 1991-92 | 1992-93 | 1993-94 | Total |
|---|---|---|---|---|---|---|---|
| 300 | 2 | 0 | 1 | 0 | 3 | 2 | 8 |
| 301 | 1 | 2 | 2 | 2 | 1 | 2 | 10 |
| 302 | 1 | 3 | 2 | 0 | 0 | 0 | 6 |
| 303 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 311 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 312 | 1 | 0 | 1 | 0 | 3 | 4 | 9 |
| 313 | 2 | 1 | 1 | 0 | 0 | 1 | 5 |
| 314 | 2 | 1 | 2 | 2 | 5 | 5 | 17 |
| 315 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 317 | 1 | 2 | 2 | 3 | 3 | 5 | 16 |
| 318 | 0 | 0 | 2 | 0 | 0 | 0 | 2 |
| 319 | 0 | 0 | 1 | 0 | 1 | 3 | 5 |
| 320 | 1 | 0 | 1 | 0 | 1 | 2 | 5 |
| 321 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| 322 | 0 | 1 | 0 | 1 | 3 | 1 | 6 |
| 325 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 326 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 328 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 330 | 1 | 0 | 0 | 0 | 0 | 1 | 2 |
| 331 | 1 | 0 | 3 | 1 | 2 | 3 | 10 |
| 333 | 0 | 0 | 1 | 1 | 2 | 0 | 4 |
| 335 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 340 | 0 | 0 | 0 | 0 | 2 | 1 | 3 |
| 343 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 350 | 0 | 0 | 0 | 1 | 2 | 2 | 5 |
| 360 | 2 | 3 | 1 | 2 | 0 | 1 | 9 |
| 361 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 362 | 1 | 0 | 1 | 0 | 0 | 0 | 2 |
| 370 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| 380 | 0 | 0 | 0 | 1 | 2 | 4 | 7 |
| 390 | 1 | 0 | 2 | 0 | 1 | 0 | 4 |
| 391 | 0 | 0 | 0 | 1 | 2 | 3 | 6 |
| 392 | 1 | 4 | 2 | 4 | 3 | 5 | 19 |
| 393 | 0 | 1 | 0 | 1 | 0 | 1 | 3 |

| Hunting Dist. | 1988-89 | 1989-90 | 1990-91 | 1991-92 | 1992-93 | 1993-94 | Total |
|---|---|---|---|---|---|---|---|
| 410 | 1 | 0 | 1 | 0 | 1 | 0 | 3 |
| 411 | 1 | 0 | 1 | 0 | 1 | 5 | 8 |
| 412 | 0 | 1 | 3 | 1 | 4 | 4 | 13 |
| 413 | 2 | 0 | 6 | 1 | 2 | 4 | 15 |
| 414 | 2 | 0 | 0 | 1 | 0 | 0 | 3 |
| 416 | 2 | 1 | 1 | 3 | 3 | 7 | 17 |
| 418 | 0 | 0 | 3 | 2 | 1 | 4 | 10 |
| 420 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 422 | 1 | 2 | 0 | 4 | 3 | 3 | 13 |
| 423 | 0 | 0 | 1 | 1 | 5 | 0 | 7 |
| 424 | 4 | 0 | 2 | 1 | 0 | 3 | 10 |
| 427 | 1 | 0 | 1 | 0 | 0 | 0 | 2 |
| 429 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 432 | 0 | 4 | 1 | 1 | 4 | 3 | 13 |
| 435 | 0 | 0 | 1 | 0 | 0 | 3 | 4 |
| 439 | 0 | 0 | 0 | 2 | 3 | 3 | 8 |
| 441 | 3 | 4 | 2 | 1 | 1 | 3 | 14 |
| 442 | 3 | 2 | 5 | 6 | 4 | 7 | 27 |
| 443 | 1 | 0 | 2 | 2 | 1 | 1 | 7 |
| 445 | 0 | 0 | 0 | 0 | 4 | 2 | 6 |
| 446 | 0 | 0 | 0 | 0 | 3 | 6 | 9 |
| 448 | 0 | 3 | 0 | 0 | 1 | 3 | 7 |
| 449 | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| 452 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 454 | 1 | 2 | 0 | 0 | 0 | 2 | 5 |
| 455 | 0 | 0 | 0 | 4 | 1 | 0 | 5 |
| 510 | 0 | 0 | 1 | 0 | 0 | 2 | 3 |
| 511 | 1 | 0 | 1 | 1 | 3 | 5 | 11 |
| 520 | 6 | 4 | 5 | 4 | 6 | 9 | 34 |
| 530 | 2 | 0 | 1 | 0 | 1 | 0 | 4 |
| 540 | 1 | 2 | 3 | 2 | 4 | 4 | 16 |
| 560 | 6 | 5 | 7 | 7 | 10 | 9 | 44 |
| 570 | 0 | 0 | 1 | 2 | 0 | 1 | 4 |
| 575 | 1 | 1 | 2 | 3 | 4 | 4 | 15 |
| 580 | 0 | 0 | 0 | 1 | 3 | 1 | 5 |
| 590 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 621 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 680 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| 690 | 0 | 0 | 0 | 0 | 2 | 3 | 5 |
| 700 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 702 | 0 | 0 | 1 | 0 | 1 | 0 | 2 |
| 704 | 0 | 1 | 0 | 0 | 1 | 3 | 5 |

* Significant modifications were made in this table compared to last years table of results.

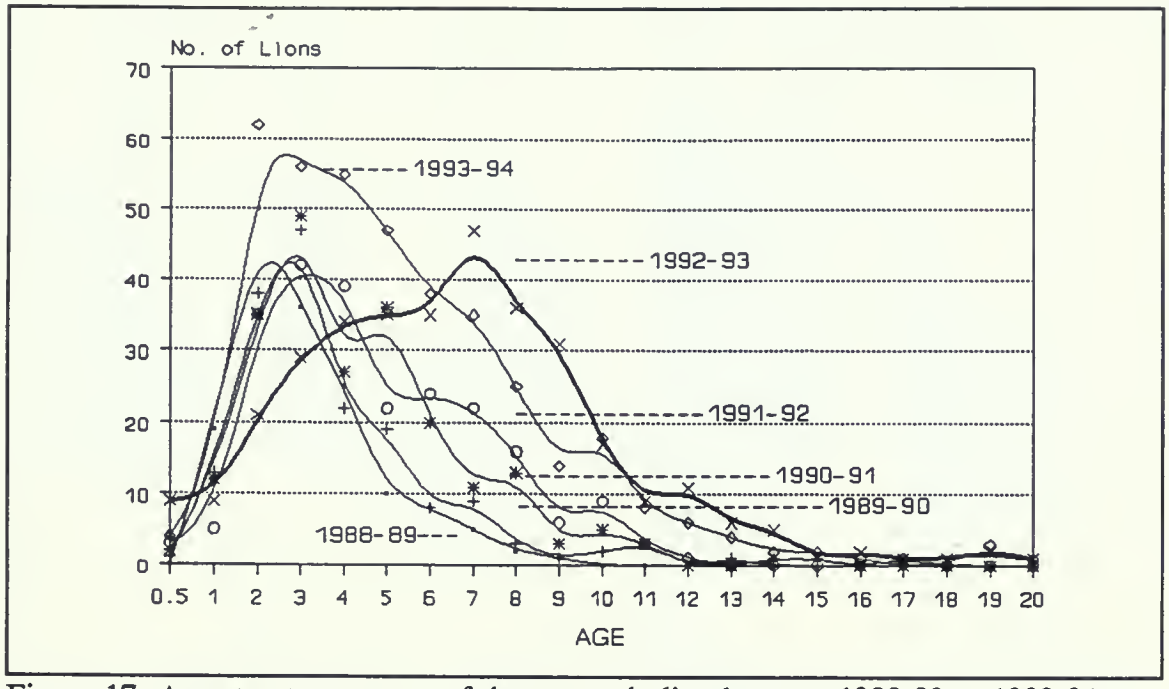


Figure 17. Age structure curves of the mountain lion harvest, 1988-89 to 1993-94.

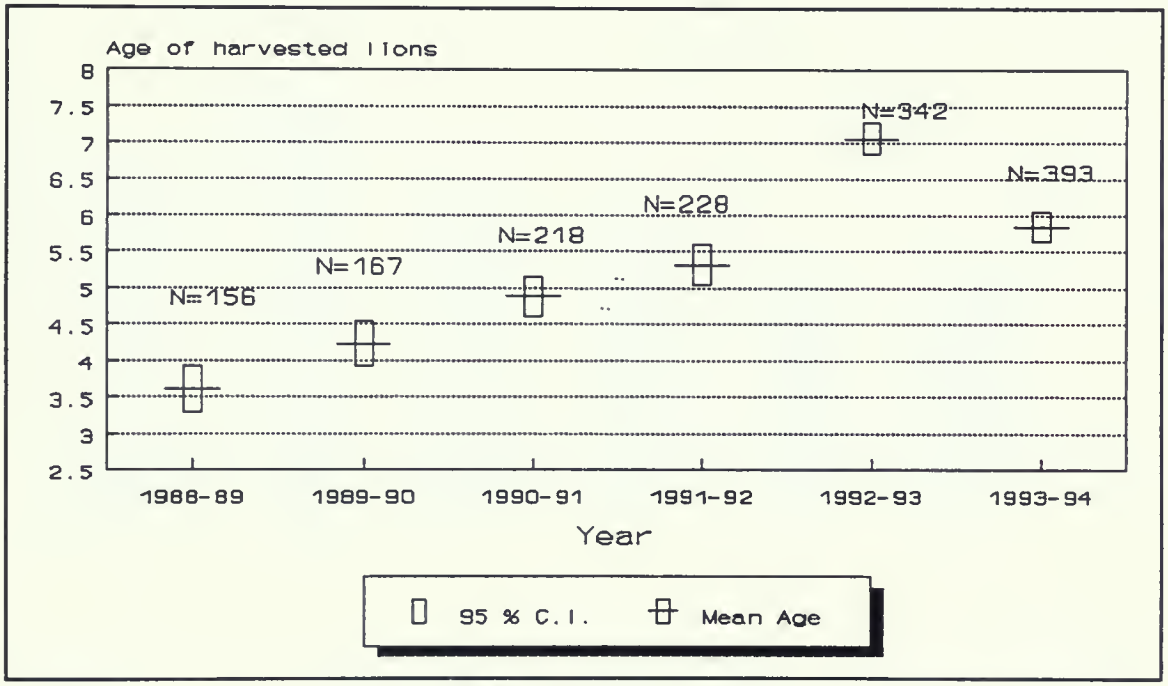


Figure 18. The mean age and 95% confidence interval of harvested mountain lions, 1988-89 to 1993-94.

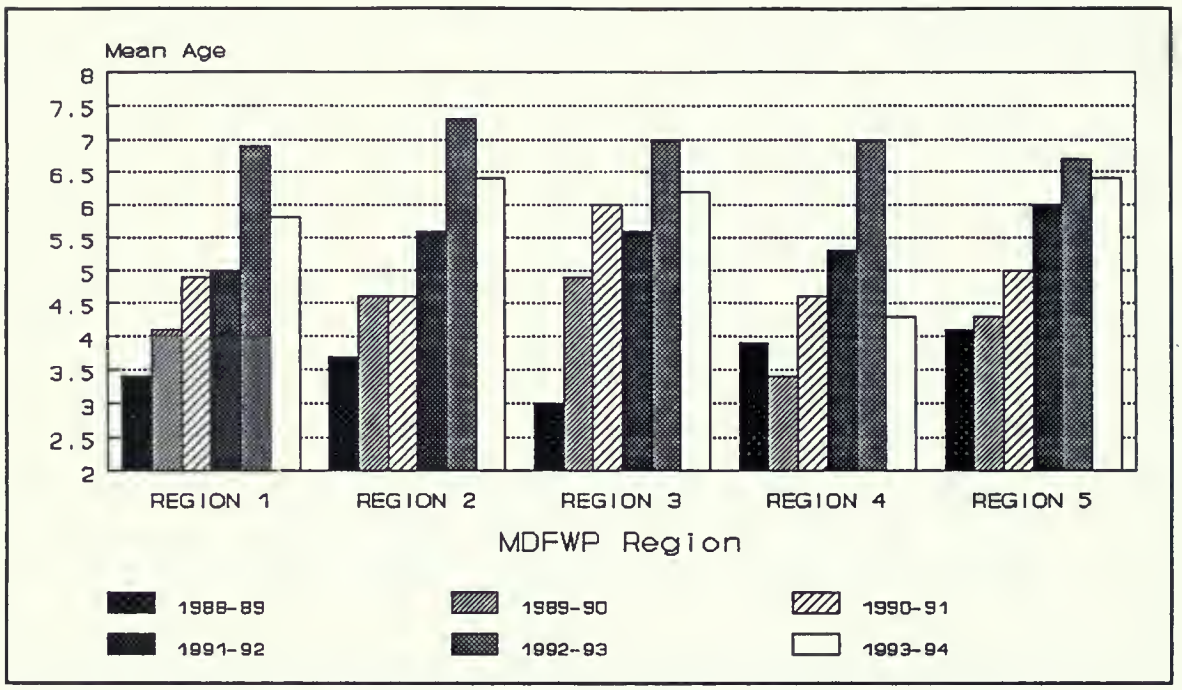


Figure 19. The mean age of mountain lions by region, 1988-89 to 1993-94.

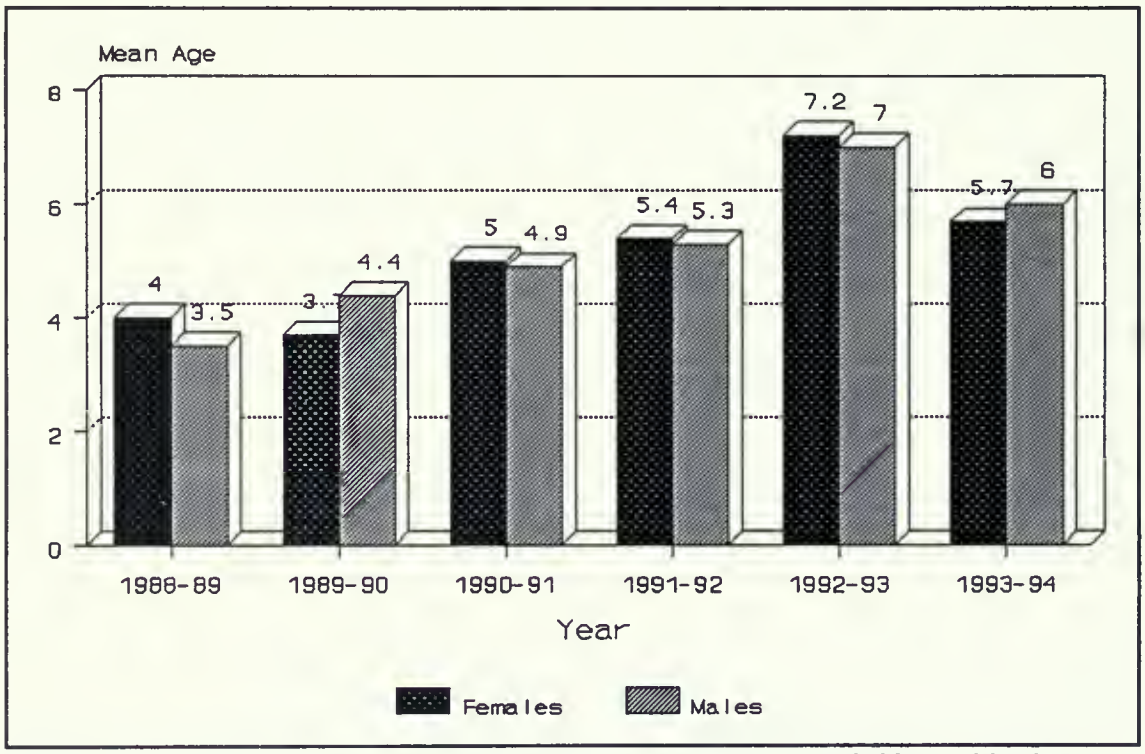


Figure 20. Mean age of lions harvested statewide by sex, 1988-89 to 1993-94.

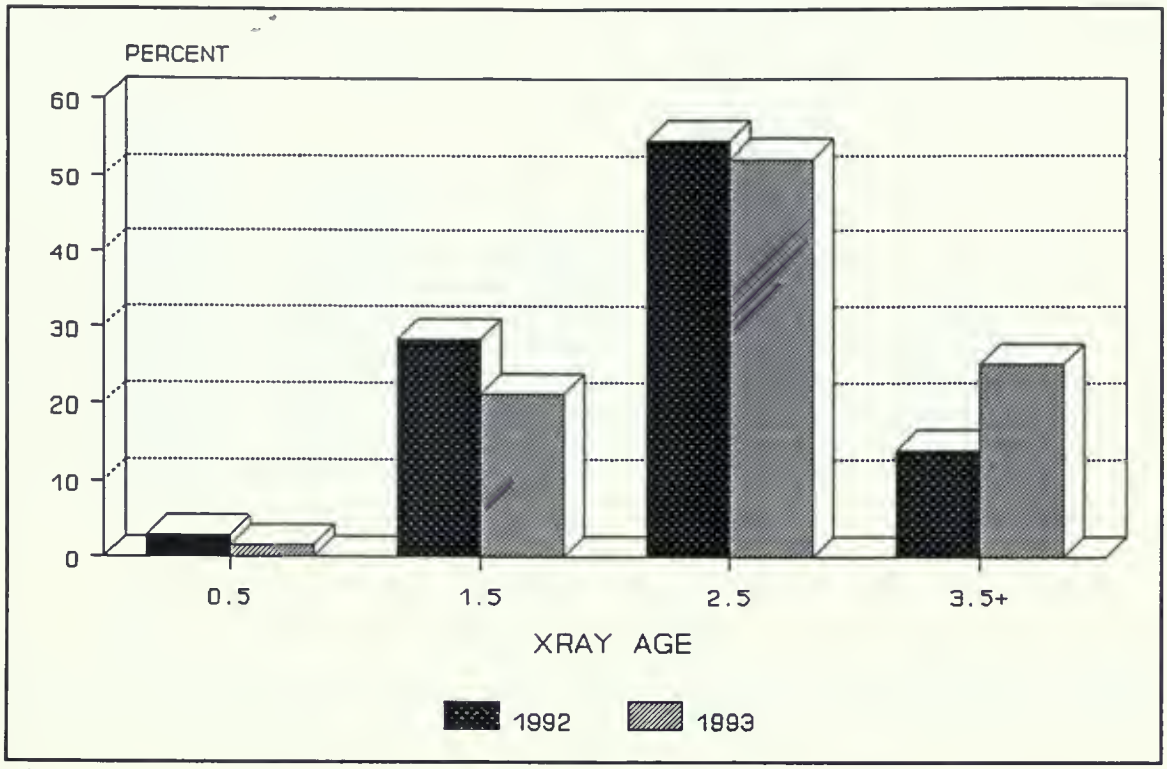


Figure 21. Comparisons between the 1992-93 and 1993-94 lion harvest using x-ray age technique.

Actions of the lions were classified as involving livestock attacks, pet attacks, nuisance situations, predatory/aggressive behavior toward humans, and human attacks. All human attacks required actual contact with the human and resulting injuries inflicted by the cat on humans. Predatory/aggressive behavior exhibited toward humans involved charges and sneak approaches toward humans, clawing the air, and vocalizations. In these aggressive exhibits, no actual contact is made with the human involved. Nuisance situations involved lions frequently seen near homes, ranches, or communities.

Forty-eight mountain lion incidents were reported in FY1994 (Fig. 22). The most frequent interactions involved livestock attacks and predatory/aggressive interactions where the mountain lion is perceived as a threat to an individual (Fig. 23). The number of aggressive/predatory encounters reported rose from 6 in FY1990 to 16 in FY1992, then declined in FY1993 and 1994.

There appears to be significant differences in lion incident types and trends varying with human use and demographic patterns within the state. The number of incidents in Regions 2 and 3 increased significantly in 1994 while declining or remaining stable in all other regions (Fig. 24). Livestock-lion incidents are the most frequently reported interaction in Regions 4 and 5, while human-lion incidents occur more frequently in Regions 1 and 2 (Fig. 25).

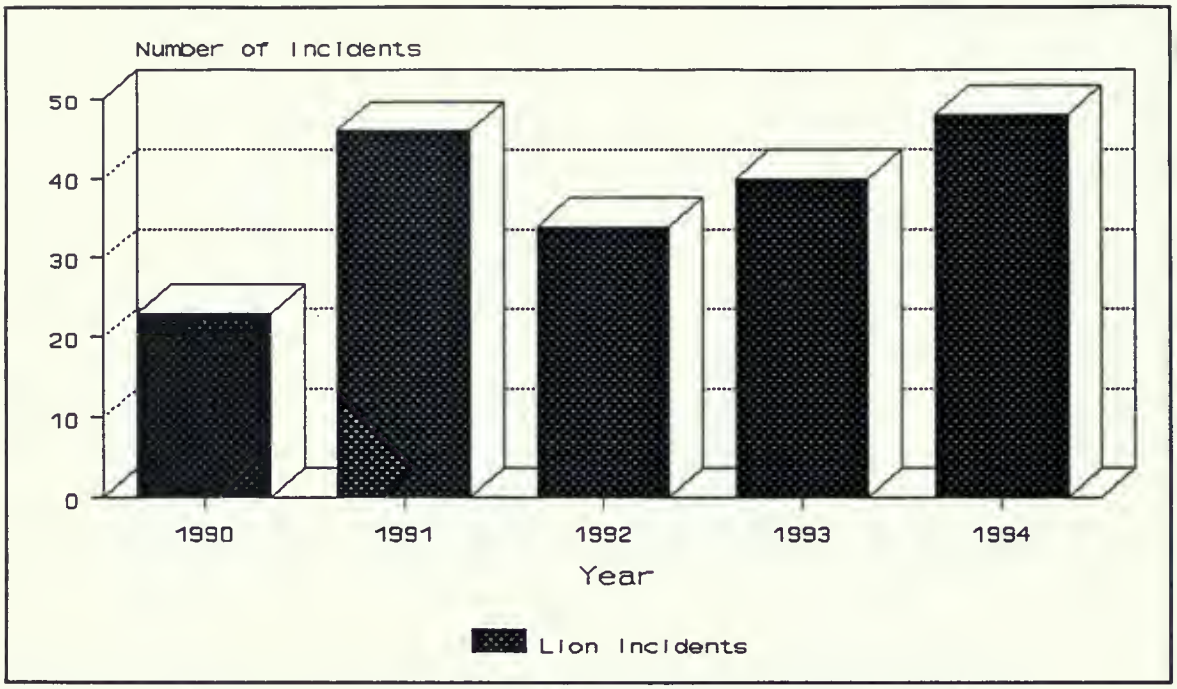


Figure 22. Mountain lion incidents in Montana during fiscal years 1990-94.

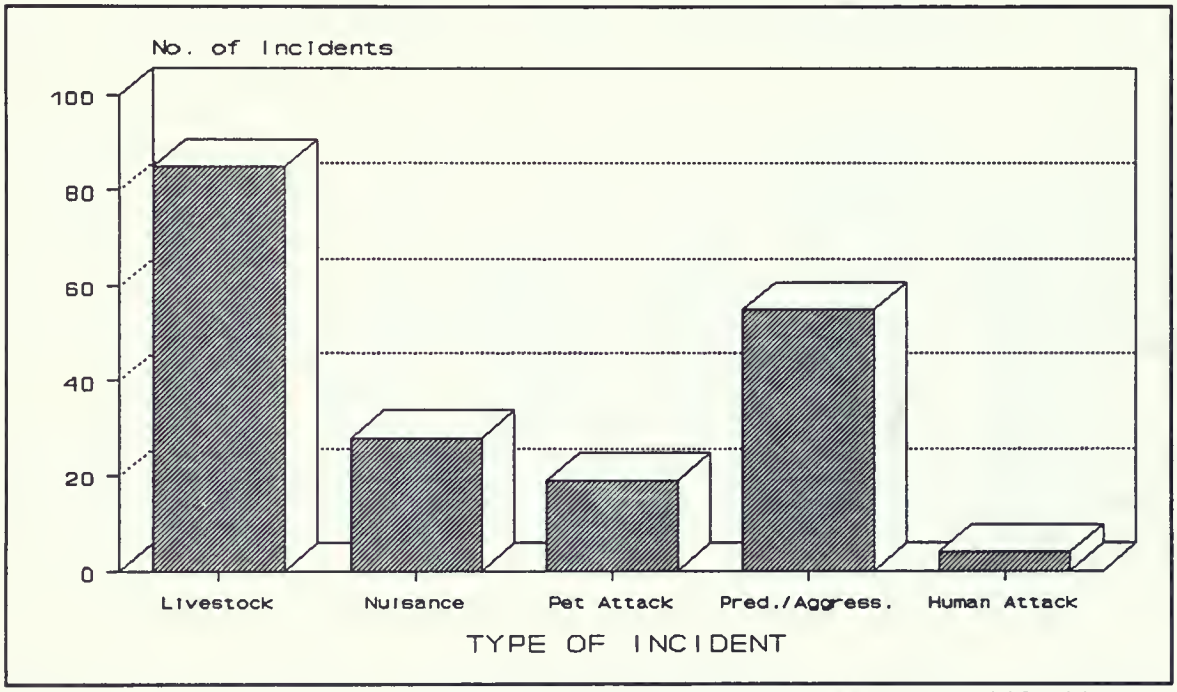


Figure 23. Frequency of mountain lion incidents by class in Montana, 1989-1994.

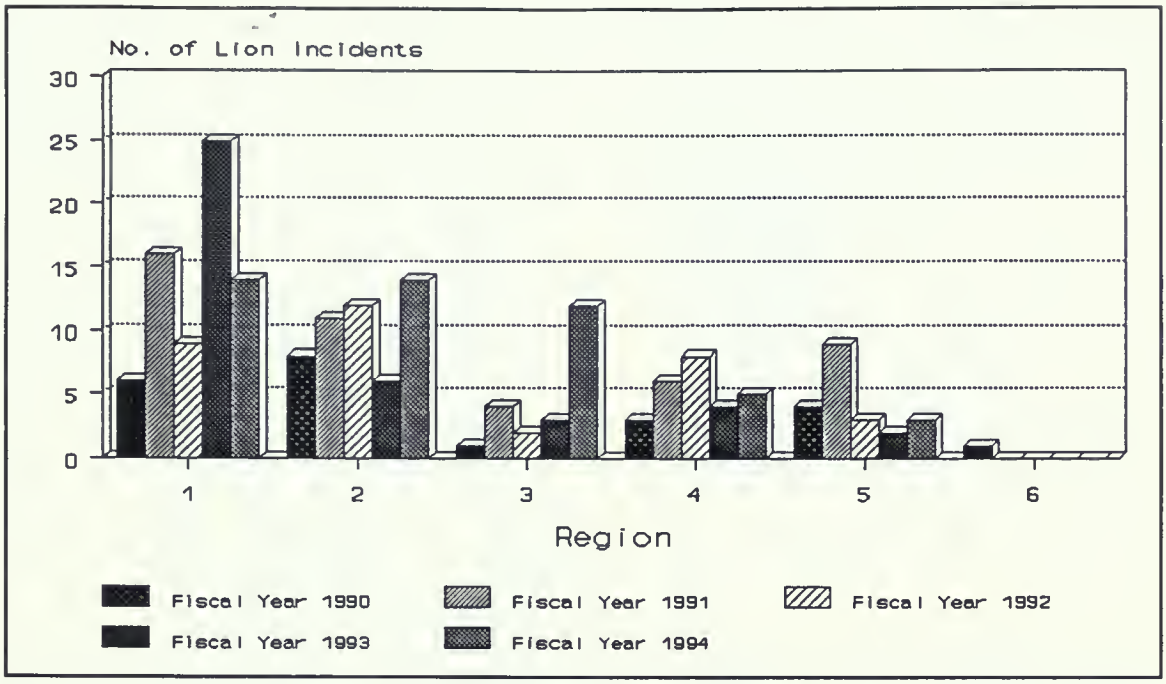


Figure 24. Comparison of reported lion incidents in Montana by fiscal years, 1990-94.

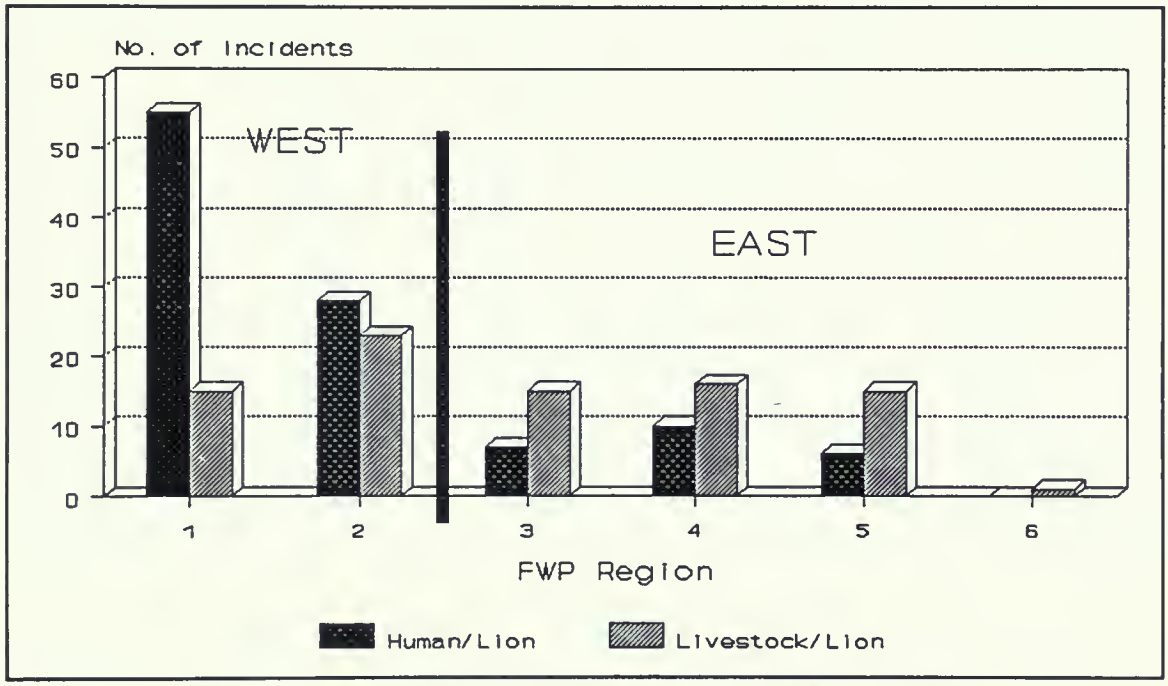


Figure 25. Human/lion and livestock/lion incidents by region in Montana, 1989-94.

Eighty-five (44.5%) of the 191 incidents reported in this period were classified as livestock attacks. Lions were captured, then relocated or killed in 40 (47.0%) of the livestock cases. Fifty-seven of the cases (67.0%) involved sheep. Other reported livestock/lion incidents involved rabbits, goats, poultry, cattle, and horses. Livestock cases primarily occurred in the April-October period (Figure 26). There was a significant increase in mountain lion depredations on domestic sheep in 1994.

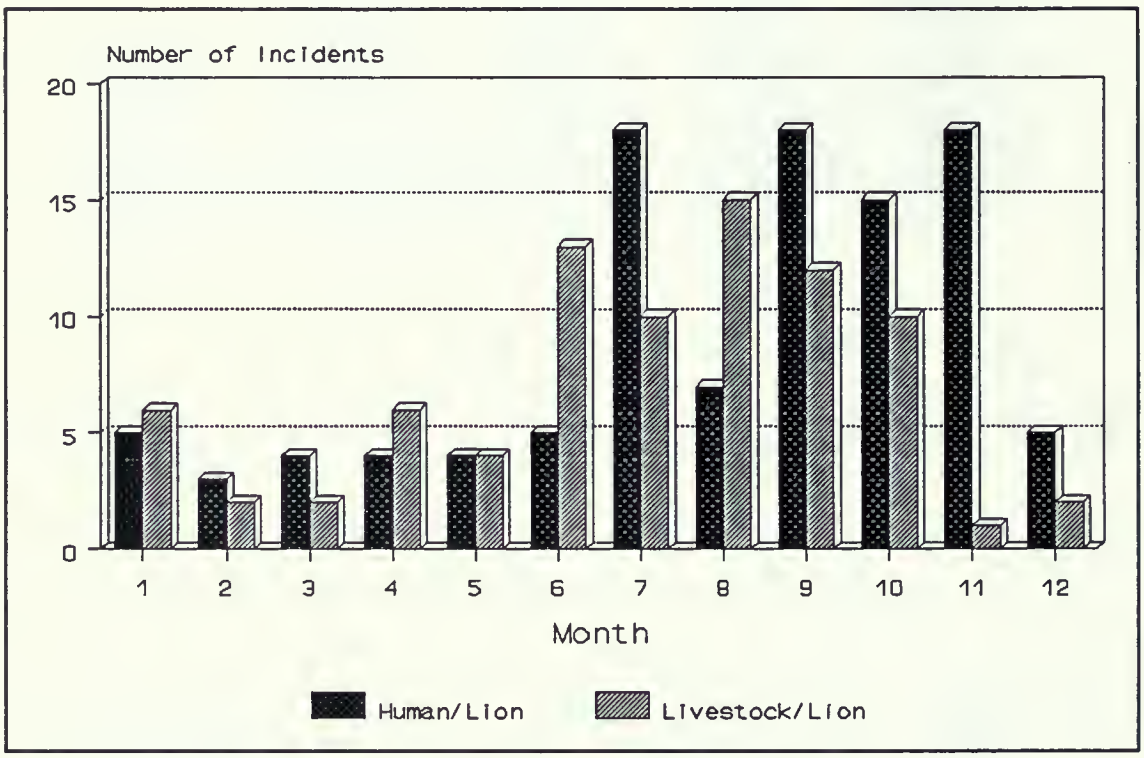


Figure 26. Human/lion and livestock/lion incidents by month, 1989-94.

Aune (1991) found that the ratio of males to females consistently skewed toward males in livestock-lion interaction while females were more prevalent in human-lion interactions. Continued examination of sex ratios in offending lions confirms this observation (Fig. 27). Ages were recorded for 92 of the lions involved in the 191 incidents. Fifty-six (60.9%) of the lions whose age could be determined were aged as 2 or less (Figure 28). Aune (1991) hypothesized that most of the lions were dispersing subadults. Further investigations confirm that most offending lions are young or subadult.

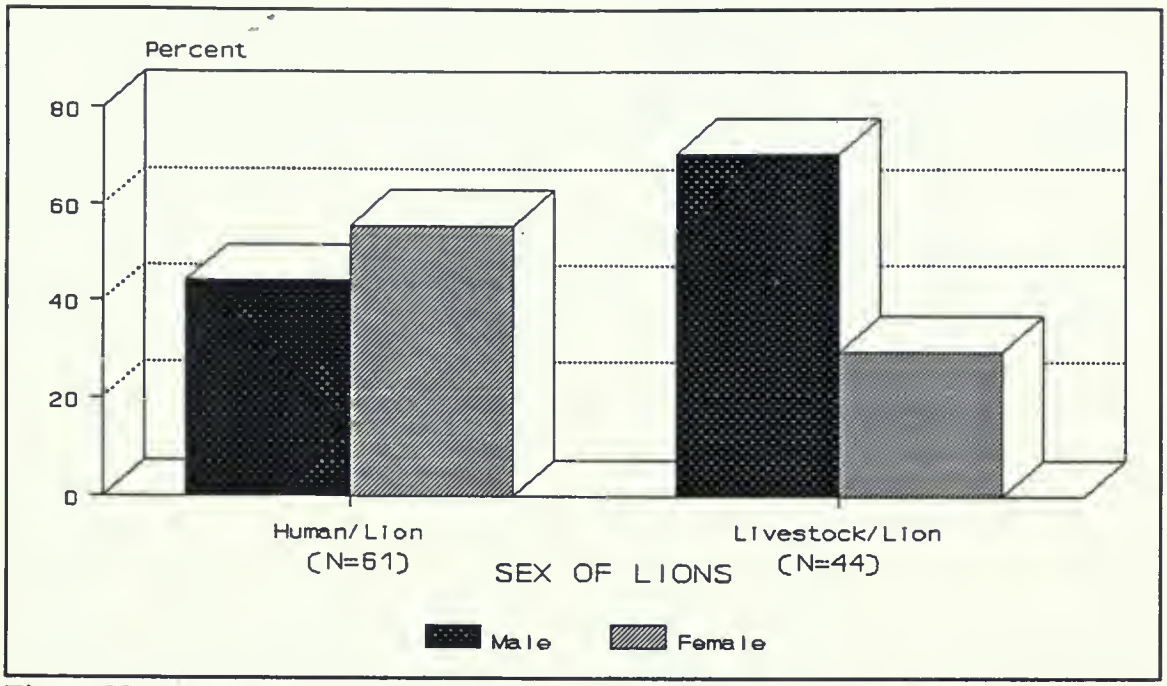


Figure 27. Sex ratio of mountain lions involved in human/lion and livestock/lion interactions in Montana, 1989-94.

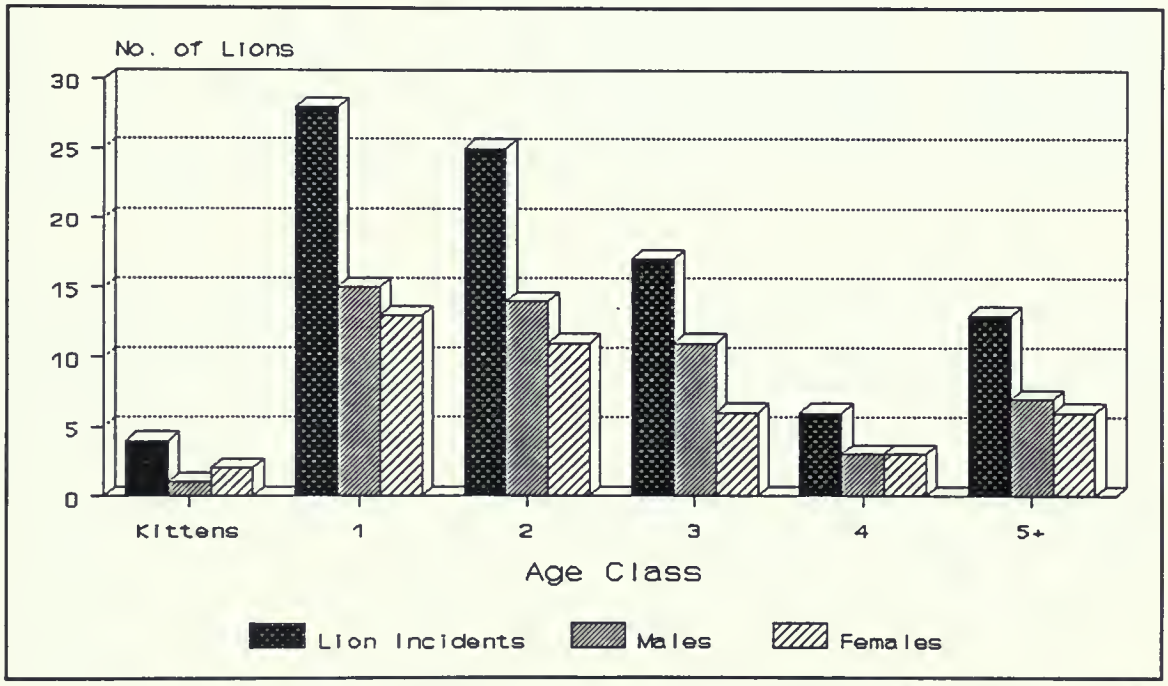


Figure 28. Age of mountain lions involved in all lion incidents in Montana, 1989-94.

Mountain lions actions reported to MFWP by the APHIS/ADC has increased since 1967 (Fig. 29). A significant and continuous need for field actions occurred beginning in 1983. Prior to 1983, APHIS/ADC records of depredation actions were infrequent. A sudden and significant increase in ADC lion actions occurred in 1993 and 1994.

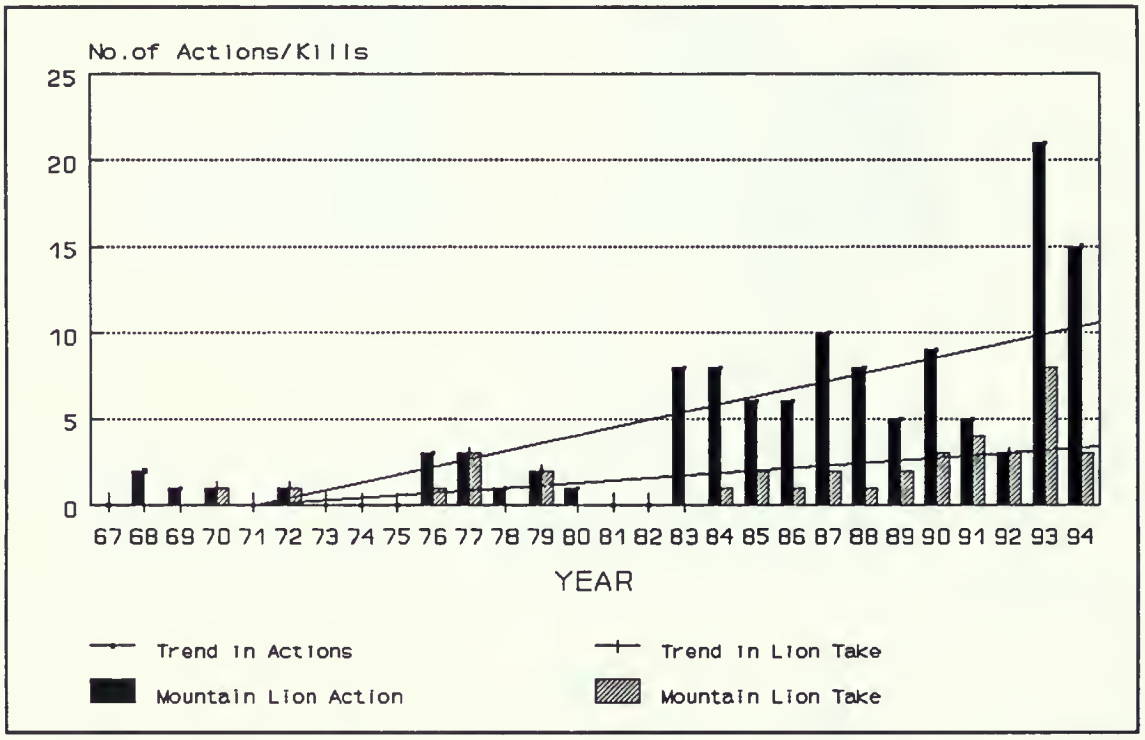


Figure 29. APHIS/ADC mountain lion depredation actions in Montana, 1967-94.

Stomach contents were examined from 60 mountain lions involved in human/lion interactions. Twenty-one stomachs were empty. Nine lions fed on domesticated pets including cats and dogs. Nine had fed on domestic livestock. Fourteen had fed on white-tailed deer, two on mule deer, and one on an elk. Three lions had fed on small mammals. One lion stomach contained only cloth and debris. Lions stomachs with anthropogenic food resources comprised 49% of lion stomachs with food contents. Of seventeen lions involved in livestock depredations, nine (53%) had stomach contents providing clear evidence of the depredations.

## Fisher Carcass Study

Prior to 1985, all incidentally trapped fisher were turned in to MFWP. Following regulation changes in 1985, trappers were allowed to keep fisher furs. However, it became mandatory to provide the skinned carcass for research purposes. Occassionally, the skull only was provided. There have been inconsistencies in the numbers of carcasses provided by trappers and the number of harvest registrations reported. To correct for errors in harvest registration data, carcass collection data was examined to derive a reconciled harvest summary (Fig. 30). Several years produced more carcasses than registrations recorded in the harvest data.

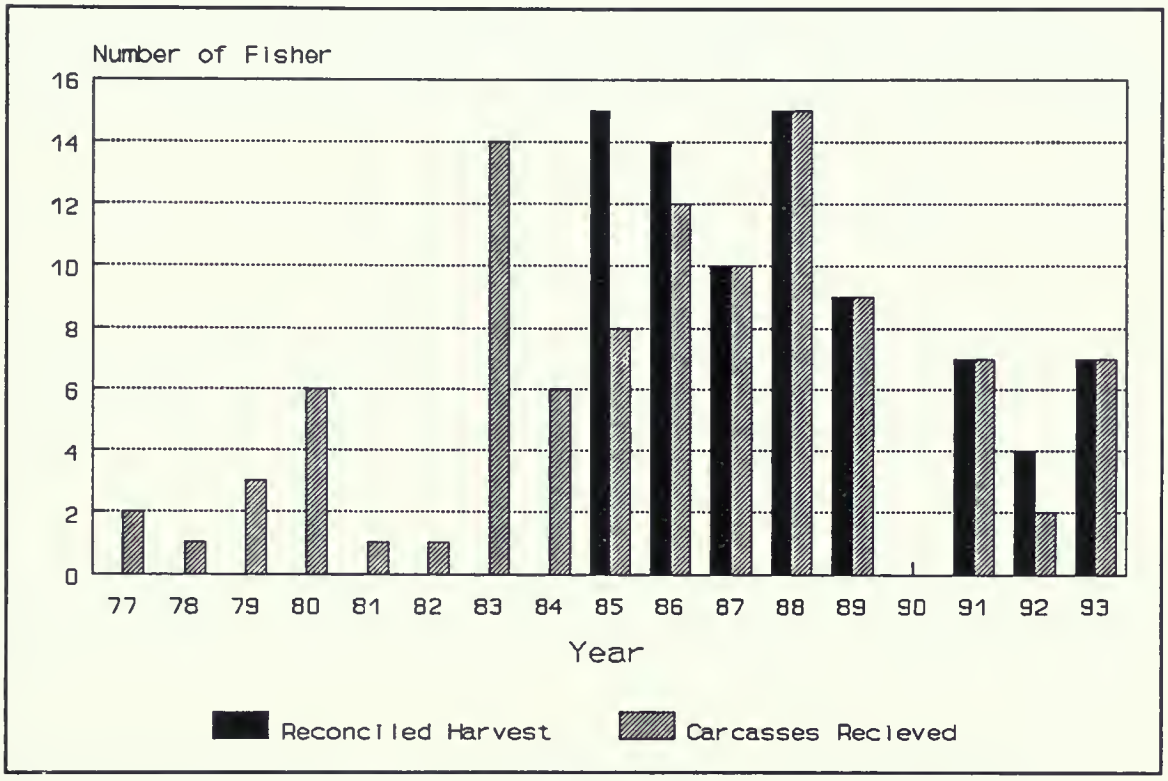


Figure 30. Fisher harvest and carcass collections in Montana, 1977-1993.

One hundred four fisher carcasses or skulls have been examined at the Wildlife Laboratory since 1977. All specimens examined were trapped in Regions 1 or 2. Thirty-one specimens were identified from Region 1, while 54 samples were known to come from Region 2. An additional 19 specimens came from western Montana but the region of collection was not known.

The trapping district was recorded on registration forms for 73% of specimens collected. Region 1 specimens were collected from hunting districts 103, 104, 110, 121, 123, 130, 131, and 140. Region 2 specimens came from hunting districts 201, 202, 203,

204, 210, 240, 250, 270, 283, and 285. Harvest registrations also indicate fisher were trapped on the Blackfeet and Flathead Indian Reservations in Montana. However, carcasses are not required to be examined from these jurisdictions.

### Age and Sex Structure

Sex was determined for 101 specimens. Sex ratios statewide were 50% male and 50% female. Sex ratio in Region 1 was 60F:40M. Sex ratio for Region 2 specimens were 40F:60M. There was a statistical difference in sex ratios of specimens when comparing Regions 1 and 2 (Chi-square 7.988, 1 d.f., P=0.005).

Ages were not yet available from the fisher harvest in 1993. Results will be compiled in the FY95 annual report. The reader is referred to Aune and Schladwieler (1993) for a complete summary of fisher age and sex information compiled from 1977-1992.

## Pine Marten Carcass Study

### Age and Sex Structure of the Harvest

Pine marten age structure curves were derived from carcass collections in Region 1 for 1989-1993 and Region 3 for 1987-1993. We were unable to construct age distributions for Region 2 because of variable participation in the carcass collections and inconsistent or small sample sizes.

Pine marten age structure in Region 3 has been somewhat variable (Fig. 31). The decline in percentage of juveniles in 1989 and 1992 were dramatic. A reduced sample of carcasses in 1992 could explain some of the variation in 1992. Age structure in Region 1 has been very stable from 1989-1991, then the percentage of juveniles declined abruptly also in 1992 (Fig. 32).

The mean age of pine marten in Region 1 has varied from 1.2 to 2.2 and averaged 1.61 from 1989-93. The mean age has risen significantly from 1989 to 1992, then declined slightly in 1993 (Fig. 33). The mean age of pine marten in Region 2 was similar for the years 1989, 1990, and 1993 (Fig. 34). An insufficient number of carcasses were collected in Region 2 to calculate mean age for other years. The mean age of pine marten in Region 3 has varied from 1.32 to 1.87, and averaged 1.62 from 1987-1993. There was no significant change in the mean from 1987 to 1993 (Fig. 35).

Sex ratio of the harvest in all regions has been similar between years and between regions (Table 19). The percentage of females in the harvest has remained between 43 and 50% for the years sampled. The percent females in the harvest rose sharply in both Regions 1 and 3 during 1993.

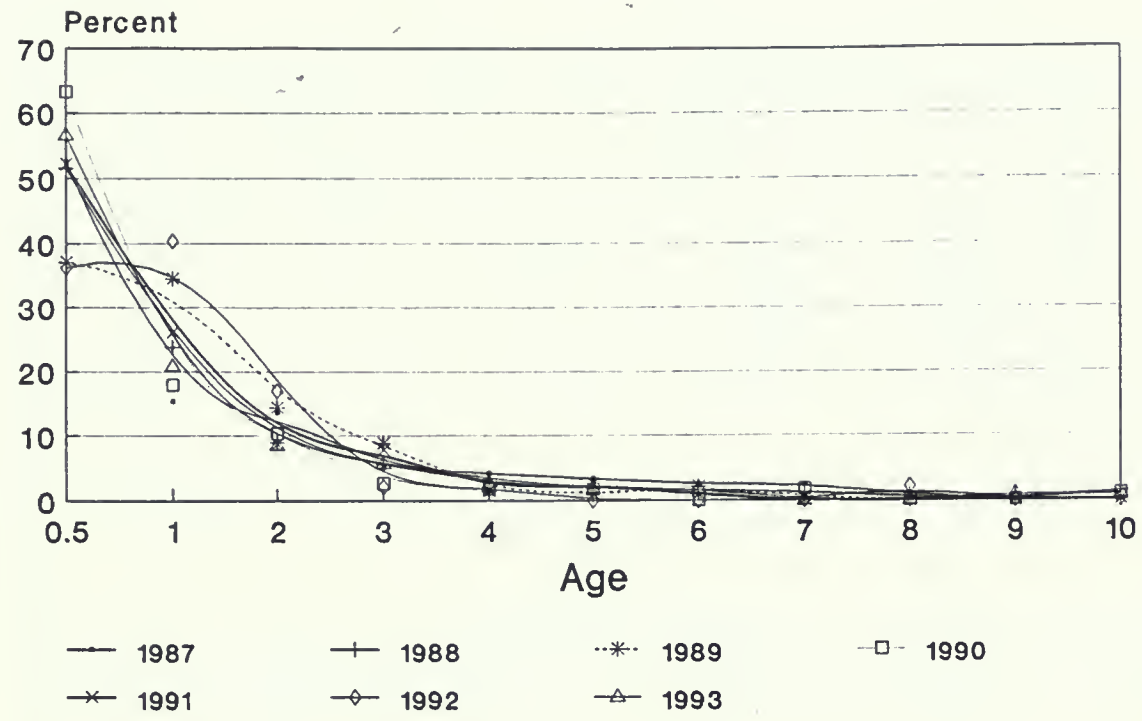


Figure 31. Pine marten age distribution curves for Region 3, 1987-1993.

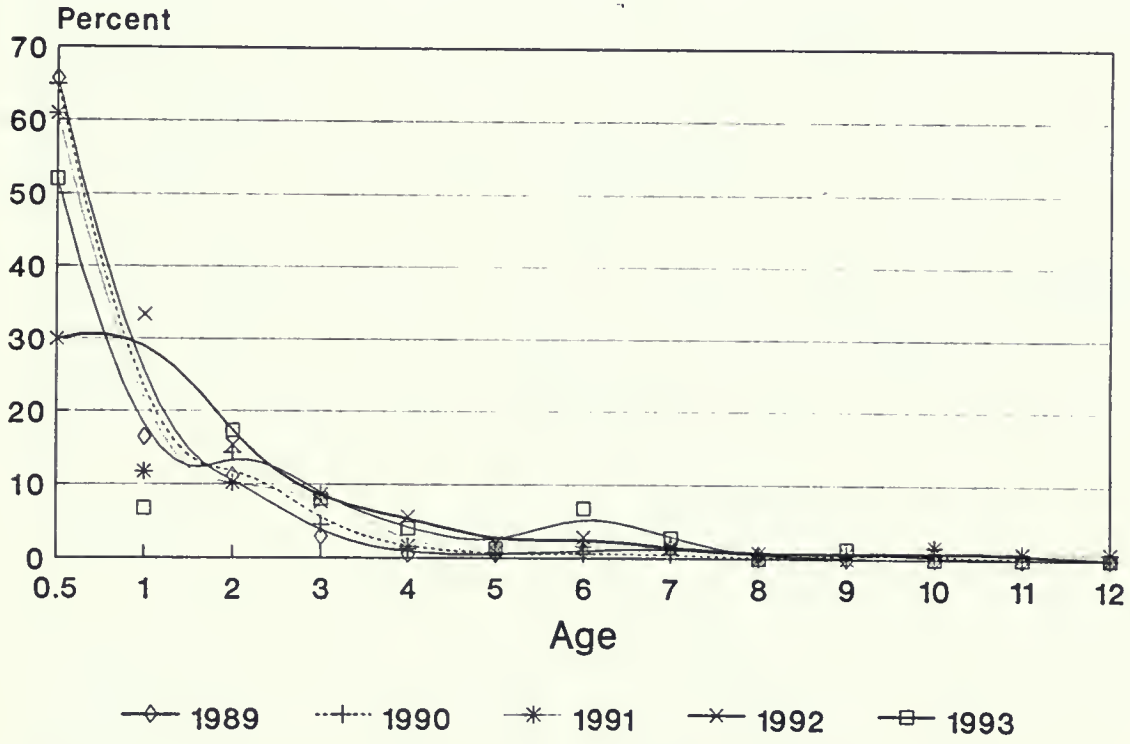


Figure 32. Pine marten age distribution curves for Region 1, 1989-1993.

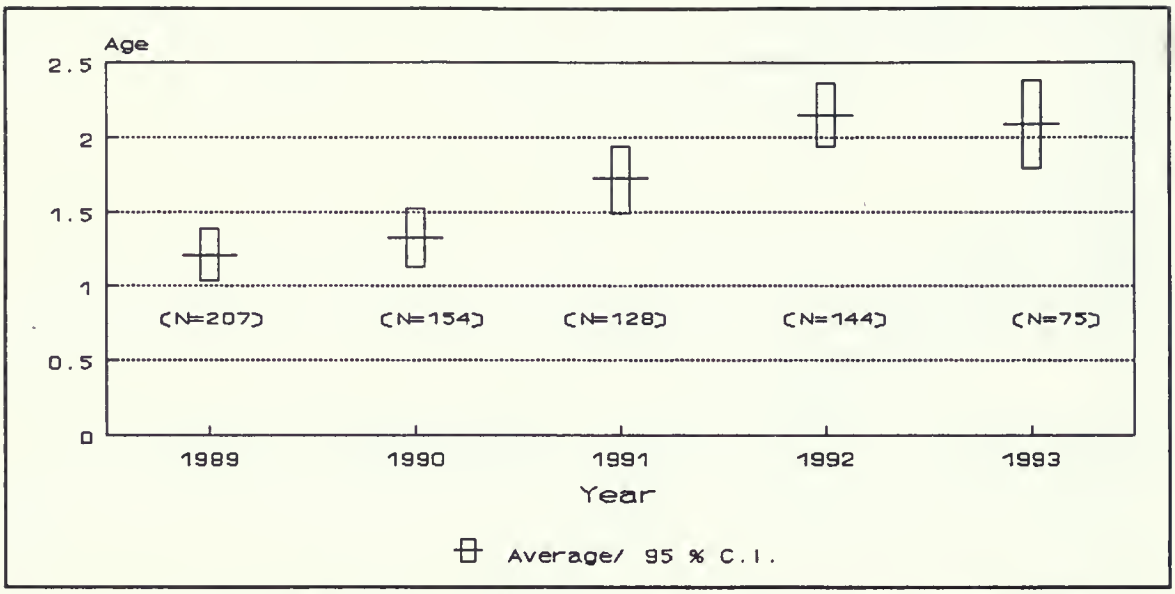


Figure 33. The mean age and 95% confidence interval for pine marten collected in Region 1, 1989-93.

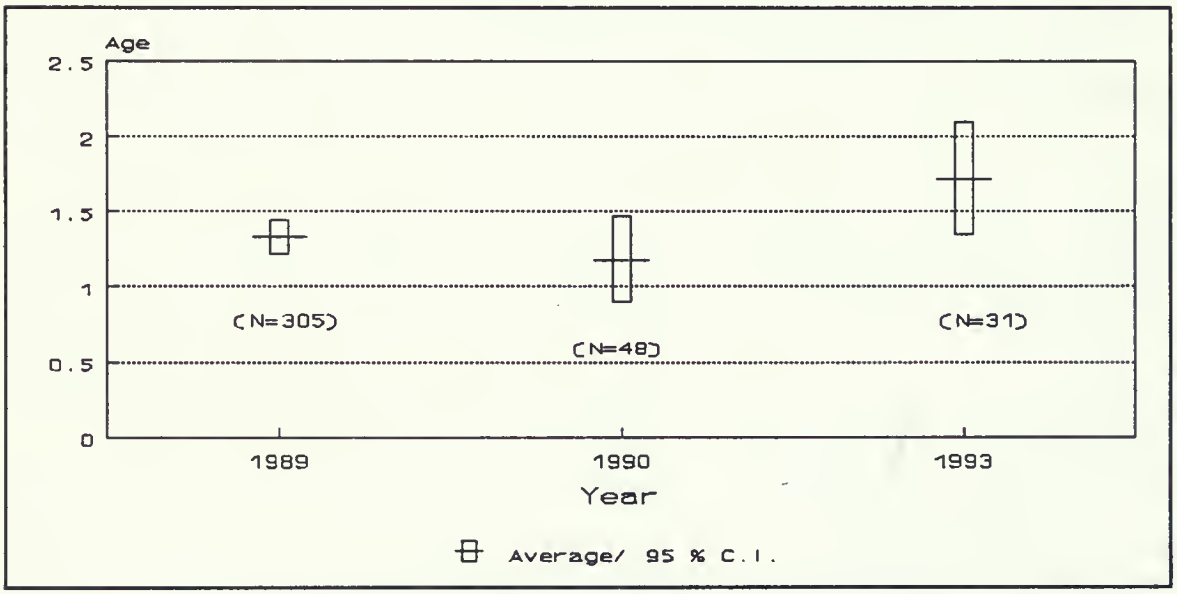


Figure 34. The mean age and 95% confidence interval for pine marten collected in Region 2, 1989, 1990 and 1993.

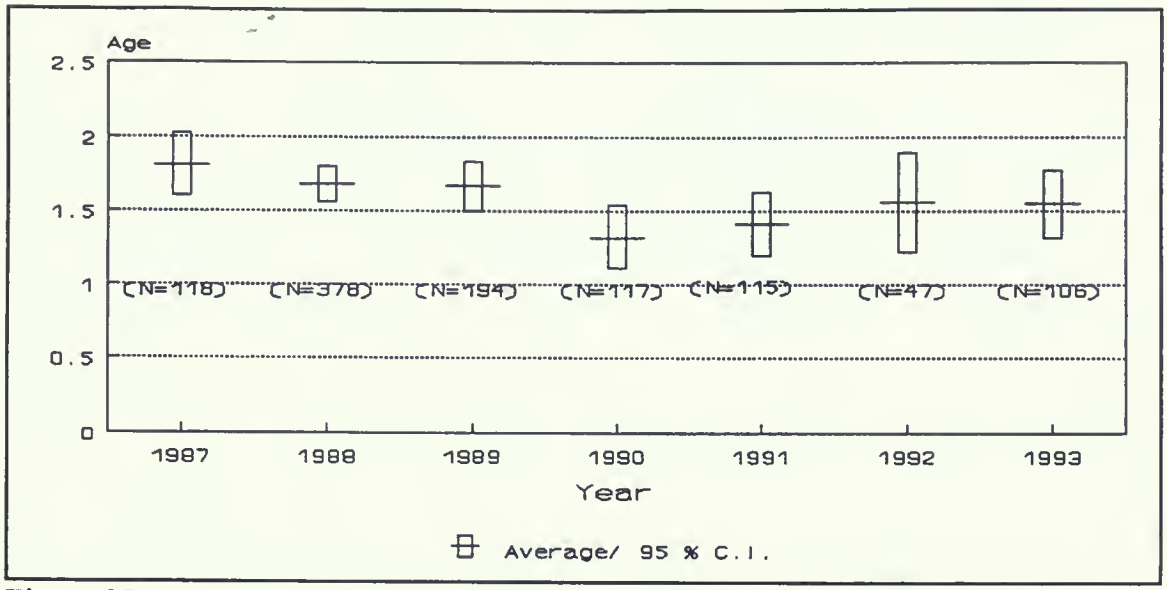


Figure 35. The mean age and 95% confidence interval for pine marten collected in Region 3, 1987-1993.

Table 19. Percent females in the pine marten harvest by region and year.

| Region\Year | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|---|
| Region 1 | - | - | 40.2 | 41.3 | 34.5 | 41.6 | 53.3 |
| Region 2 | - | - | 43.7 | 32.7 | - | - | 45.2 |
| Region 3 | 43.0 | 42.7 | 42.8 | 42.9 | 43.7 | 46.1 | 51.0 |

Data from both Regions 1 and 3 indicate that the harvest of juveniles declined sharply in 1992. We could not confirm this pattern in Region 2 because only seven carcasses were submitted for the season. The cause of the apparent decline in juvenile marten in 1992-93 is unknown. Field research on pine marten in Region 3 also indicated a decline in juveniles during 1992 (Ken Coffin, pers. comm.). The proportion of juveniles in the 1993-94 harvest returned to normal values.

## Pine Marten Food Habits

Pine marten food habits were examined from 1988 through 1992. Stomachs or colons were not collected in 1993. A complete summary of all winter food habits from the pine marten carcasses is pending. A published paper is being prepared for presentation at the Predator Conference in Yellowstone National Park. The reader is referred to previous reports for annual summaries of food habits.

**Bobcat Studies**

Bobcat skulls were collected from trappers in Regions 2 and 3 during the 1988-89 through 1993-94 trapping seasons. Age was determined by examining the pulp cavity to discern juveniles followed by cementum annuli counts for those older than juvenile. The mean age of bobcats collected in Regions 2 and 3 combined has remained stable since 1988 (Table 20). Mean age of the bobcats collected from each region has declined, but not significantly from 1988 to 1993 (Table 21). There was no difference in the mean age of males and females for the years 1988-89 through 1993-94 (Table 22) ($P < 0.05$).

Table 20. Mean age of bobcats collected in Regions 2 and 3, 1988-1993.

| Year | N | Mean Age | 95% C. I. |
|---|---|---|---|
| 1988-89 | 129 | 2.50 | 2.24-2.76 |
| 1989-90 | 105 | 2.47 | 2.18-2.76 |
| 1990-91 | 69 | 2.11 | 1.74-2.47 |
| 1991-92 | 183 | 2.13 | 1.91-2.35 |
| 1992-93 | 194 | 2.36 | 2.16-2.59 |
| 1993-94 | 199 | 2.93 | 2.71-3.16 |

Table 21. Mean age of bobcats by year and region, 1988-1993.

| Parameter | N | Region 2 | N | Region 3 |
|---|---|---|---|---|
| Mean Age 1988-89<br>95% C.I. | 25 | 2.22<br>1.61-2.83 | 41 | 2.60<br>2.18-3.01 |
| Mean Age 1989-90<br>95% C.I. | 82 | 2.51<br>2.17-2.85 | 20 | 2.10<br>1.50-2.70 |
| Mean Age 1990-91<br>95% C.I. | 47 | 2.07<br>1.63-2.52 | 17 | 2.44<br>1.80-3.09 |
| Mean Age 1991-92<br>95% C.I. | 64 | 2.20<br>1.81-2.58 | 72 | 1.92<br>1.60-2.23 |
| Mean Age 1992-93<br>95% C.I. | 102 | 2.42<br>2.12-2.73 | 73 | 2.28<br>1.96-2.59 |
| Mean Age 1993-94<br>95% C.I. | 98 | 2.58<br>2.26-2.90 | 87 | 3.25<br>2.90-3.59 |

Table 22. The mean age of male and female bobcat in Region 2 and 3 combined by years.

| | Mean Males | 95% Confidence Interval | Mean Females | 95% Confidence Interval |
|---|---|---|---|---|
| 1988-89 | 2.50 | 1.45-3.55 | 1.93 | 0.88-2.97 |
| 1989-90 | 2.57 | 2.11-3.04 | 2.50 | 1.96-3.04 |
| 1990-91 | 2.24 | 1.76-2.72 | 2.07 | 1.54-2.59 |
| 1991-92 | 2.42 | 2.09-2.76 | 1.65 | 1.29-2.00 |
| 1992-93 | 2.41 | 2.06-2.75 | 2.10 | 1.81-2.39 |
| 1993-94 | 2.90 | 2.59-3.22 | 2.57 | 2.20-2.94 |

The sex ratio of all bobcats harvested in Regions 2 and 3 combined was similar for all years except 1992-93, when a high proportion of females were harvested (Table 23). The sex ratio of bobcats harvested for this same period shifted significantly in both Regions 2 and 3 (Table 24).

Table 23. Sex ratio of harvested bobcats in southwest Montana, 1988-1992.

| Sex | 1988-89 | 1989-90 | 1990-91 | 1991-92 | 1992-93 | 1993-94 |
|---|---|---|---|---|---|---|
| Female | 47.4 | 40.0 | 42.4 | 44.1 | 55.3 | 45.7 |
| Male | 52.6 | 60.0 | 57.6 | 55.9 | 44.7 | 54.3 |

Table 24. Sex ratio of harvested bobcats by MFWP region, 1991-1992 and 1993-94.

| Sex | Region 2 | | | Region 3 | | |
|---|---|---|---|---|---|---|
| | 1991-92 | 1992-93 | 1993-94 | 1991-92 | 1992-93 | 1993-94 |
| Female | 40.0 | 55.7 | 45.2 | 43.3 | 52.5 | 41.5 |
| Male | 60.0 | 44.3 | 54.8 | 56.7 | 47.5 | 58.5 |

Annual age distributions for Regions 2 and 3 combined for 1988-89 through 1993-94 were developed (Fig. 36). The number of juveniles has remained stable, fluctuating between 29 and 35.5% until 1993-94, when it dropped significantly. Few bobcats were

aged over 9 years old, and the oldest was aged at 14.5 years. Juveniles and one year old bobcats comprised an average of 54.7% of the population for this period.

A comparison of age distributions for Regions 2 and 3 for the most recent two years indicated little change between years (Figs. 37 and 38).

The percentage of juveniles in Region 2 has varied from 24.0% in 1988 to 37.5% in 1991. The percentage of juveniles in Region 3 has fluctuated widely from 1988-1993 and reached a six year low of 13.8% in 1993-94. There was little difference in the age distribution curves between Regions 2 and 3.

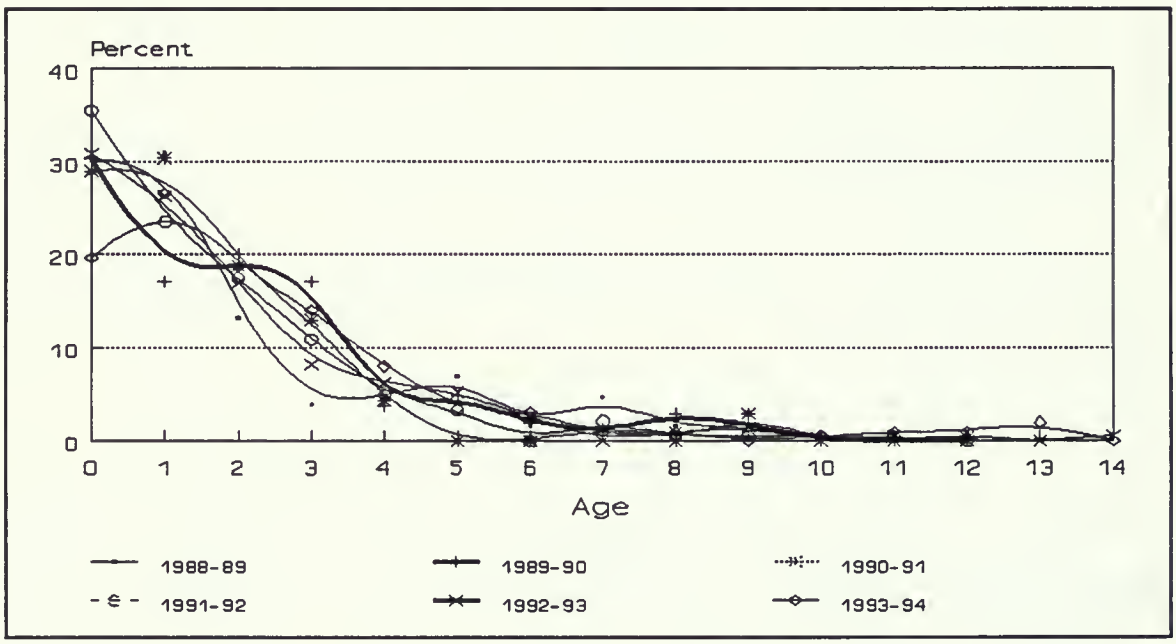


Figure 36. Comparison of bobcat age distributions for Regions 2 and 3 pooled, 1988-93.

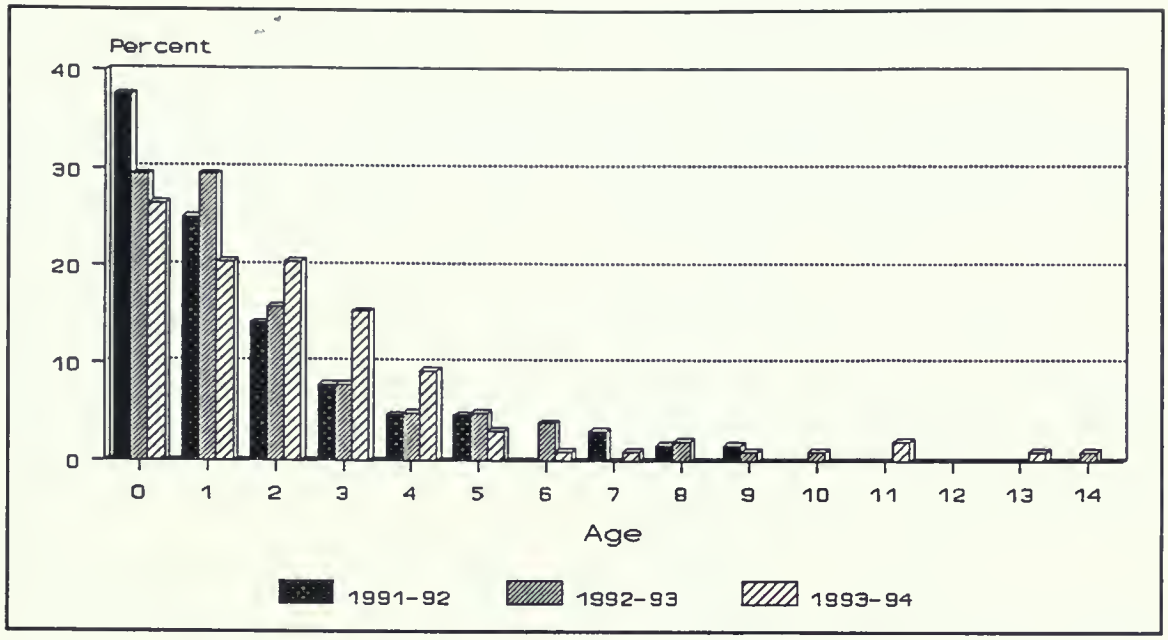


Figure 37. Comparison of the bobcat age distributions for Region 2, 1991-93.

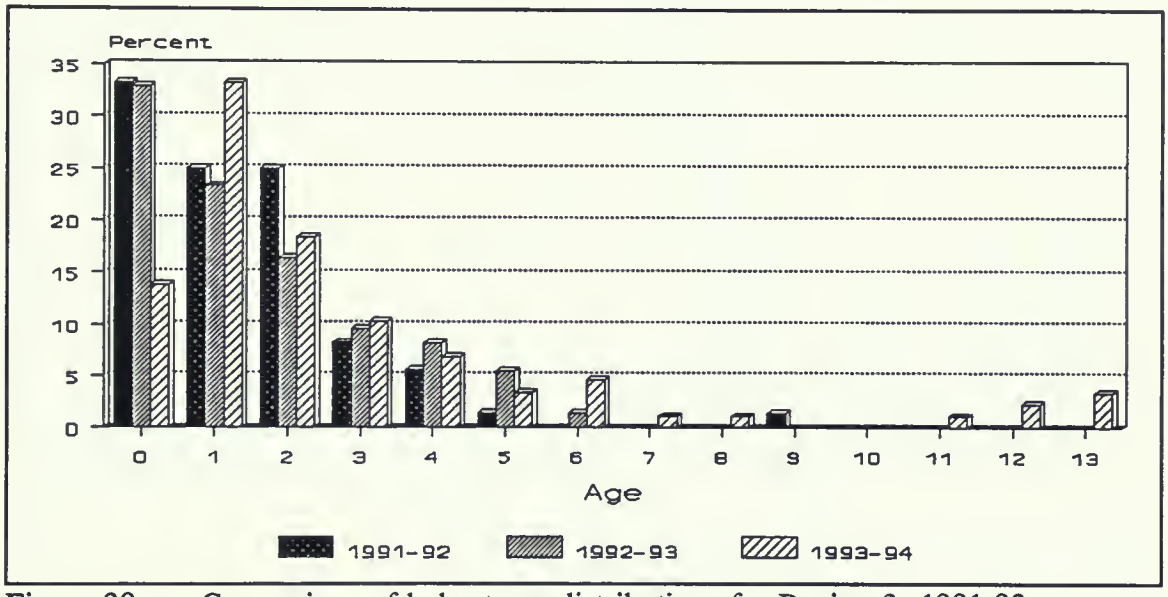


Figure 38. Comparison of bobcat age distributions for Region 3, 1991-93.

**Wolverine Studies**

Montana trappers have been required to submit wolverine carcasses to the Wildlife Laboratory since 1974. During the report period, all records of wolverine harvested since 1967 were compiled and reconciled to carcass collections (Fig. 39). The wolverine harvest has fluctuated between a low of 6 in 1992-93 and a high of 43 in 1976-77. For the most recent six years, wolverine harvest has remained below 10 annually.

Wolverine have been harvested in 59 hunting districts, from 24 Montana counties, and within the Blackfoot Indian Reservation (Table 25). Harvests have occurred in Regions 1, 2, 3, 4, 5, and 6 over the period from 1967-1994. Distribution maps of the harvest were prepared for the entire time period and for the time period stratified by 10 year increments. Graphic displays of the distribution are being prepared but were not available for inclusion into this report.

Sex ratio of the harvest initially favored females until the most recent years when males comprised over 50% of the harvest (Fig. 40). There was a significant increase in the ratio of male to female wolverine (Chi-Square = 2.064, P=0.15) when comparing the time period 1975-83 with 1984-94.

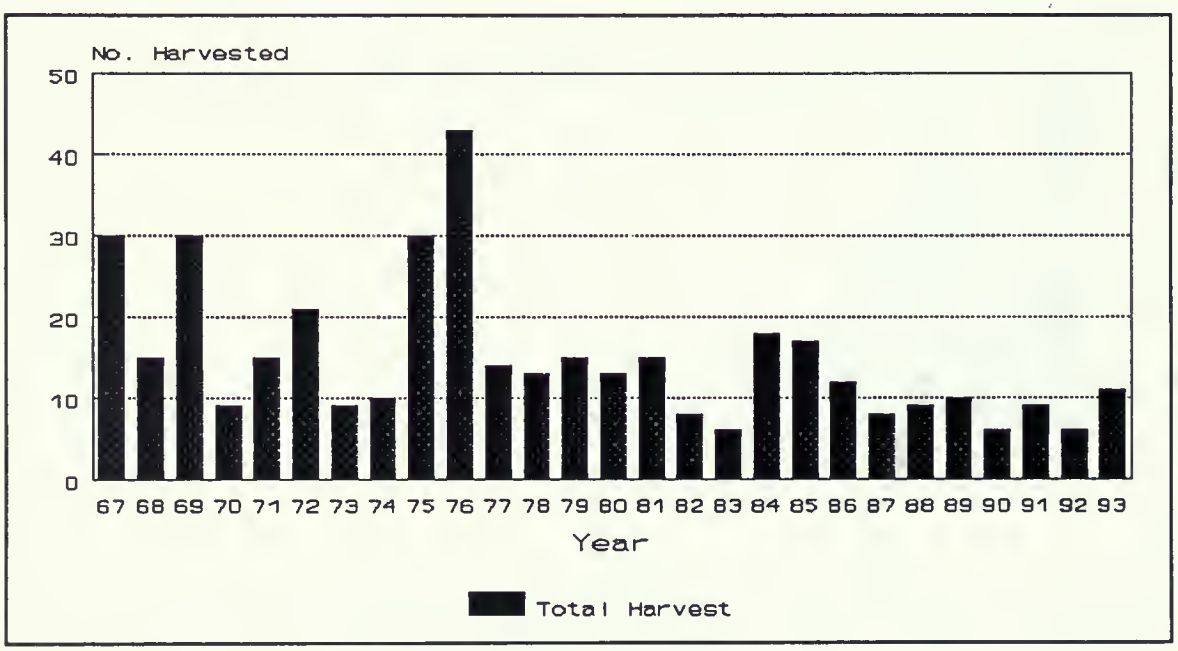


Figure 39. Wolverine harvests since 1967.

Table 25. Counties in Montana with at least one harvested wolverine, 1967-1994.

| County | No. Harvested | County | No. Harvested |
|---|---|---|---|
| Beaverhead | 20 | Lincoln | 22 |
| Blaine | 1 | Madison | 4 |
| Broadwater | 3 | Meagher | 2 |
| Deerlodge | 2 | Mineral | 8 |
| Flathead | 67 | Missoula | 17 |
| Gallatin | 17 | Park | 38 |
| Glacier | 9 | Pondera | 2 |
| Granite | 6 | Powell | 13 |
| Jefferson | 2 | Ravalli | 5 |
| Judith Basin | 2 | Sanders | 4 |
| Lake | 5 | Teton | 5 |
| Lewis and Clark | 8 | Yellowstone | 1 |

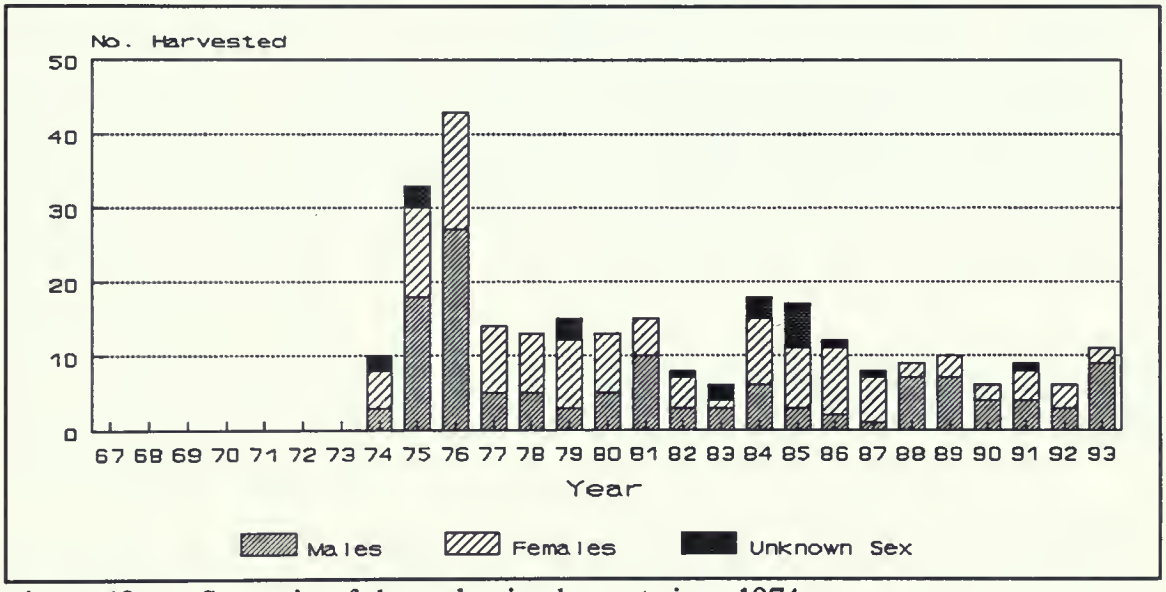


Figure 40. Sex ratio of the wolverine harvest since 1974.

**Lynx Harvest Reconciliation**

During the fiscal year lynx harvest records were examined to reconcile harvest registrations and carcass collections. From 1977 through 1994, a total of 477 lynx have been harvested (Fig. 41). A record of skull or carcass examinations can be assigned to only 39 specimens. Efforts are continuing to reconcile laboratory records with registration records.

Sex was recorded for 445 records, and the sex ratio of the harvested lynx was 51% female and 49% male. Age was recorded for 37 specimens. Juveniles and yearlings comprised 29.7% of the harvest. The oldest age recorded for lynx was 13.5 years.

At least one lynx was harvested from 34 counties (Table 26). A distribution map was developed for lynx and is being edited for distribution in FY95.

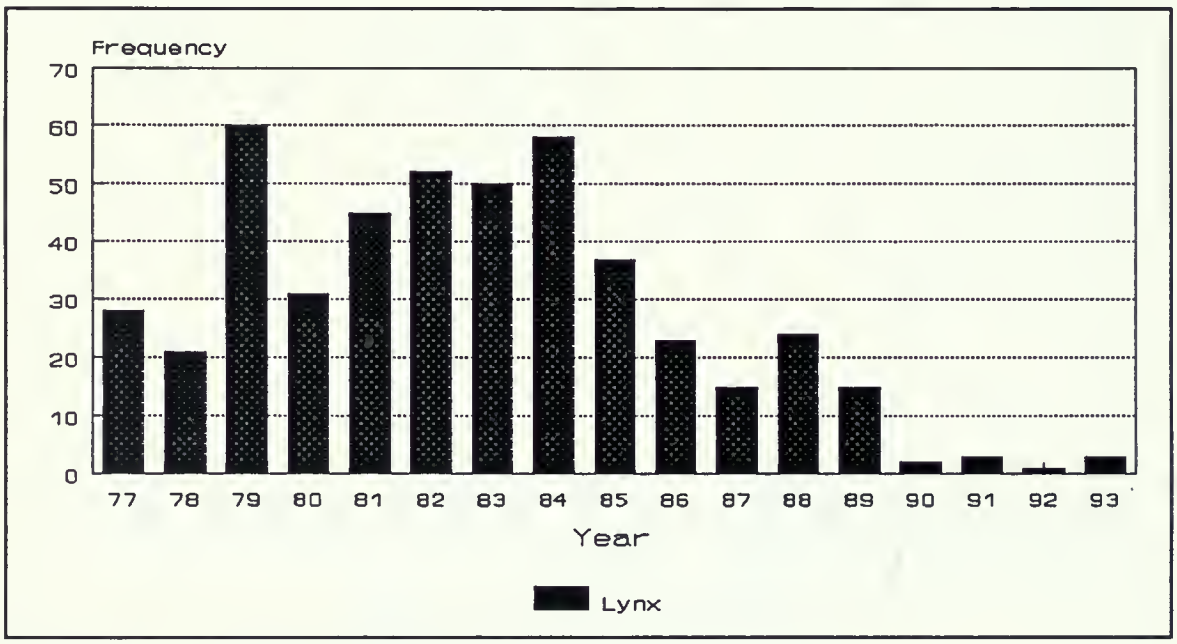


Figure 41. Lynx harvests since 1977.

Table 26. Counties with at least one lynx harvest for the period 1977-1994.

| County | No. Harvested | County | No. Harvested |
|---|---|---|---|
| Beaverhead | 20 | Lincoln | 52 |
| Blaine | 1 | Madison | 3 |
| Carbon | 1 | Meagher | 1 |
| Cascade | 1 | Mineral | 9 |
| Choteau | 1 | Missoula | 61 |
| Daniels | 1 | Musselshell | 1 |
| Deerlodge | 8 | Park | 6 |
| Fergus | 2 | Phillips | 1 |
| Flathead | 89 | Pondera | 1 |
| Gallatin | 1 | Powell | 20 |
| Glacier | 22 | Ravalli | 22 |
| Granite | 17 | Sanders | 3 |
| Jefferson | 3 | Silverbow | 6 |
| Judith Basin | 1 | Stillwater | 2 |
| Lake | 3 | Sweetgrass | 2 |
| Lewis and Clark | 78 | Teton | 29 |
| Liberty | 1 | Yellowstone | 1 |

RECOMMENDATIONS

Wildlife laboratory services should continue. Sufficient flexibility should be maintained in order to be able to readily respond to changing needs of wildlife management and research biologists.

Efforts should continue to update computer data files from large raw data compilations so that information is more readily available to biologists and managers. Computer-assisted data analysis should be continued in order to publish and distribute data on many topics of interest including mountain lion harvest data, food habits, reproductive performance of selected species, diseases and parasites of selected wildlife, and blood profiles.

## Furbearer Studies

Pine marten, fisher, lynx, and wolverine carcass collections should continue. However, the funding of this program must continue to be specifically directed to the laboratory so that budgeting and manpower planning can be more easily conducted.

## Bear Studies

A field effort should be continued on the Flying D Ranch to validate the monitoring techniques applied there and to test the feasability of using fecal nitrogen to monitor habitat conditions on a relative scale. Proposals for outside funding need to be written and submitted if internal sources of funding are not possible.

The establishment of a protocol for processing grizzly bear carcasses has the potential to greatly increase our knowledge of bears. All carcasses which can be reasonably obtained from the field should be immediately transported to the laboratory or frozen for later examination. A concerted effort by all regions involved will be necessary, and complete cooperation from field personnel will be essential. The potential exists for functional anatomy study and serious disease and parasitology studies with the materials available from the field.

Relocating grizzly bears to resolve human/bear conflict is frequently applied in both the Yellowstone and Northern Continental Divide Ecosystems. Records in the NCDE are often unavailable for consistent review and analysis. It is recommended that copies of problem bear capture forms, flight reports, and interagency nuisance report forms from the NCDE be forwarded to the Wildlife Laboratory for filing and record keeping. Annual summaries of the information should be completed. This will provide accurate and long term record keeping of relocation efforts for review by grizzly bear managers.

## Disease Surviellance

Cooperative programs for disease surveillance should be continued. Tissue sampling should be conducted in areas near TB infected game ranches to monitor TB in wildlife. Research projects handling captured wildlife should participate when possible in the statewide serological survey for microbial agents. A blood protocol is available from the laboratory, and assistance in collection techniques can be obtained. Laboratory protocols should be developed to conduct routine fecal analysis and baermans for parasite investigations in cooperation with the Veterinary Molecular Biology Parasitology Laboratory.

Laboratory budgets need to be increased to accomodate the larger work load assumed by the increasing lion harvest. The need for vacuum packaging equipment and reducing the need to clean skulls before shipping will enhance the speed and the quality of the processing of sportsmans skulls.

The mountain lion trophy form has been modified to include a copy forwarded to the Wildlife Laboratory. This has proven successful and should continue with one modification. The hunter's telephone number and street address should be recorded on the form so that specimen returns to sportsmen can be fascilitated.

Montana mountain lions continue to be a source of conflict in some areas of Montana. The significant increase in lion problems may be assisted or exacerbated by hunting programs. Monitoring lion incidents throughout the state should be continued and will be one measure of the success by hunting programs in reducing conflicts.

Increased populations of white-tailed deer are also suggested to be a factor causing more mountain lions (Riley 1993). In some areas where whitetailed deer are increasing and mule deer are stable or declining, a shift in distribution of lions to better hunting areas could explain the sightings and increased conflicts with lions in populated areas such as the Flathead Valley. Controlling white-tailed deer populations may provide the best method to reduce lion intrusions into suburban type areas of Montana.

Lion conflict problems may not be adequately resolved by simply increasing the lion harvest through liberal quotas. The heart of the solution may lie in distributing the harvest into areas where lions are not compatible and creating a stable harvest in areas where populations of lions are compatible. Creating a zoned hunting program to target removal of potential problem lions could assist in directing harvests. Special zones where mountain lions are not compatible with increased human populations should be established with liberal general and special season regulations.

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APPENDIX A An abstract for presentation at the Martes Symposium in Edmonton, 1995

## AGE AND SEX STRUCTURE AND FECUNDITY OF MONTANA PINE MARTEN

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Age and sex structure of Montana's pine marten (*Martes americana*) were determined from 2521 trapper collected skulls for the winter trapping seasons 1987 through 1993. Age was determined from radiographs and cementum annuli. Fecundity and pregnancy rates were determined by examining 383 reproductive tracts from female marten. Corpora lutea were counted in hand sectioned and histologically prepared ovary pairs. The average number of corpora lutea found in ovaries of pregnant females was 2.62 ($N=225$, $SD=0.79$). The mean number of corpora lutea found in martens from northwestern Montana (3.1) was significantly different than the mean for southwestern Montana (2.5) ($F=6.97$, $P<0.05$). Placental scars were not detected in reproductive tracts cleared in winter green oil or fixed in 10% formalin but not cleared. Pregnancy rate for female martens aged 1.5 and greater than 2.5 years was 85.5% and 95.5% respectively. The number of males per female in annual harvests ranged from 1.01 to 1.49. The percent juveniles in the annual harvest statewide varied from 33.2-63.7 percent. Juveniles per mother ($>2.5$) ranged from 2.55-8.71 during the 5 winters. The number of juveniles per adult female ($>1.5$) ranged from 1.14-4.18. The mean age of martens harvested was 1.57 ($N=2358$, $SD=1.71$). A significant decline in the number of juveniles in the harvest occurred throughout Montana in 1992-93. The proportion of males in the harvest has declined from 1989-1993. Age distributions from annual harvests in northwestern and southwestern Montana were similar. Possible causes for variations in data between years and geographic regions of Montana are discussed. The relevance of trends in the observed data to pine marten populations are discussed.

APPENDIX B Abstract from a paper submitted to the Journal of Wildlife Diseases

**A survey of Northern Yellowstone Park and Southwestern Montana Elk (*Cervus elaphus nelsoni*) for Tuberculosis, Brucellosis, Paratuberculosis, Dictycauliasis, and Other Diseases**

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A disease surveillance project was conducted on free-ranging hunter-killed elk from 3 herd groups in proximity to Yellowstone National Park (YNP) after tuberculosis caused by *Mycobacterium bovis* was discovered in a captive herd of elk (*Cervus elaphus nelsoni*) in the area. During the winter 2 of the herd groups (areas 2 and 3) are largely composed of migrant elk which summer in YNP.

Complete or partial sets of specimens were collected from 289 elk during the 1991-92 and 1992-93 hunting seasons. Specimens were tested for tuberculosis, brucellosis, paratuberculosis, and dictyocauliasis using histpathologic examination, bacteriological culture, identification techniques,
serologic tests, and the Baermann fecal flotation technique.

No mycobacterial lesions were noted in the specimens examined. Neither *M. bovis* nor *M. paratuberculosis* was isolated from any of the specimens cultured. Serum samples from 2 elk from area 2 and 1 elk from area 3 contained antibodies for *Brucella abortus*, and *B. abortus* biovar 1 was isolated from multiple tissues from the seropositive animal from area 3. Larvae of *Dictyocaulis vivpara* were found in 11.6 and 13.5 percent of fecal specimens from the 2 areas tested. *Pasteurella multocida* and *Actinomyces pyogenes* were isolated from a lung with purulent bronchopneumonia and abscesses. Incidental findings included actinomycosis-like lesions in the lymph nodes of the head

from 29 elk, tonsilar abscesses, parasitic lesions,in several lymph nodes and lung specimens, and large numbers of *Sarcocystis wapiti* and *Sarcocystis sybillensis*. One ectoparasite removed from the head of an elk was identified as *Neolipoptena ferrisi*, a louse fly typically found on mule deer (*Odocoileus hemionus*).

Tonsils and lymph nodes of the head were collected from an additional 99 hunter killed elk aged 3 and older from area 2 during January 1995. No lesions of tuberculosis were detected on gross or histopathologic examination.

APPENDIX C Abstract from a paper accepted in the Journal of Wildlife Disease

BOVINE TUBERCULOSIS IN A FREE-RANGING MULE DEER (*Odocoileus hemionus*) FROM MONTANA

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Journal of Wildlife Diseases, 31(3), 1995, pp. 000-000

ABSTRACT: A survey of 41 mule deer (*Odocoileus hemionus*) and three white-tailed deer (*O. virginianus*) for bovine tuberculosis was conducted on a Montana (USA) cattle ranch from 2 November 1993 through January 1994. Gross and microscopic lesions typical of tuberculosis were present in tonsil and lymph nodes of the head, thorax, and abdomen of one adult female mule deer. Additionally, a single microgranuloma considered morphologically suggestive of tuberculosis was present in one lymph node of the head of a second mule deer. Mycobacterial isolates from lymph nodes of the head and thorax of the first deer were identified as *Mycobacterium bovis*.

*Key words:* Mule deer, *Odocoileus hemionus*, tuberculosis, *Mycobacterium bovis*, game farm, pathology.Bovine Tuberculosis in a Free-ranging Mule Deer (*Odocoileus hemionus*) from Montana

APPENDIX D

**Wild Horse Island Bighorn Sheep**
Herd Health Summary

3/16/1994
Submitted By

Keith Aune, Wildlife Lab. Supervisor

Introduction

Wild Horse Island is the largest island in Flathead Lake, comprising 2160 acres of mixed forest and grassland habitats. It obtained its name from the Kootenai Indians who swam their horses to the island to protect them from marauding Blackfeet Indians. In 1855, when U.S. Army Surveyor Isaac Stevens passed by Flathead Lake, he noted a band of 60 or 70 wild horses still thrived on Wildhorse Island. Wild horses continued to be the principal livestock present on the island for the last 100 years. Island owner, Lewis Penwell, also stocked Wild Horse Island with elk, mule deer, bighorn sheep, and antelope. The elk and antelope did not take to the island, but the mule deer and sheep prospered.

The first sheep transplanted onto the island in 1939 were two yearling sheep which reportedly came from the Mission Mountains. They increased to six sheep by 1947 when six additional sheep from the Sun River were moved onto the island. Some early attempts to control the population were implemented, but records are sparse. Corral traps were set up, and annual removals were conducted (Jim Cross, pers. comm). Despite control efforts, the sheep herd grew to 240 sheep in 1972. The sheep herd suffered losses during the winter of 1972 when 58 sheep carcasses were found (Unpublished MDFWP Report). Too many sheep again crowded the island, and sixty sheep died in 1977-78, presumably from malnutrition. In 1978, the Department of Fish, Wildlife and Parks assumed ownership of the island. In 1979-80, 102 sheep were removed from Wildhorse Island and relocated because the population was too high. Attempts were made to capture and remove sheep in 1991 by trapping. Only mule deer were captured, and the sheep population remained high. Since then, the population has again increased until over 300 sheep were estimated to be present on the island in 1993. Population studies have been done on this sheep herd by Ogren (1954), Woodgerd (1964), and Matthews (1973).

Information regarding herd health history is sparse. It is known that occasional sheep die-offs occurred on the Island, but diagnostic determinations were not made. No information is available regarding serologic survey or specific disease diagnosis from this herd. Research has primarily focused on the questions of parasitism. Several published

studies present information on parasites occurring in the bighorn herd (Becklund and Senger 1967, Forrester and Senger 1964). In 1964, the incidence of lungworm infection was 92% (Forrester and Senger 1964). Worley et al. (1975) conducted a review of lungworm presence in Montana bighorn sheep and also noted lungworm in sheep from Wildhorse Island. Parasitism reported for Wild Horse Island by all of the above authors was similar to that reported for other North American bighorn sheep herds.

Operations and Methods

Sheep were net-gunned from a helicopter and physically restrained by leg hobbles. They were transported to the mainland while hanging upside down in rope slings attached to the hobbled legs or occasionally lying inside the back of the helicopter. Field crews on the mainland moved sheep to stations where blood was drawn from the jugular vein, a throat swab was taken using culturettes, fecal samples were collected, and appropriate injections administered. All sheep were given intramuscular injections of MuSe for capture myopathy, ivermectin for parasite control, and Penicillin G. Temperature was monitored and recorded. Rectal temperatures above 105 degrees resulted in added attention to reduce stress and lower body temperatures.

Sheep transplanted within the State of Montana were ear tagged with I.D tags with 5 digit numbers identifying each individual. Sheep transplanted to Oregon were tagged with Mt. Dept. of Livestock Tags with a 4 digit number. Sheep transplanted to Washington State University were marked by the university researchers.

All sheep transported to Oregon were inspected by Dick Kinyon DVM. Dr. Kinyon reported no evidence of scabies and indicated that all sheep were healthy upon his inspection. Dr. Kinyon provided consulting services for treatment of capture myopathy and for injured sheep.

Blood, fecal samples and throat cultures were transported to the Wildlife Laboratory for initial screening and preparation. Blood was centrifuged. Serum was separated and poured into serum tubes for submission to the State Diagnostic Laboratory Serology Laboratory. Whole blood was submitted to biochemical analysis at the State Diagnostic Clinical Pathology Laboratory. Culturettes were submitted to the Bacteriology Laboratory. Fecal samples were separated with half the sample submitted to the Baerman procedure and half to qualitative fecal flotation.

## Results

On December 12 and 13, 1993, 67 bighorn sheep were removed from Wild Horse Island. Sixteen were sent to Sleeping Giant, 15 to Walling Reef, 26 to Taylor-Hilgard, and 8 to Washington State University. The second trapping effort was made December 21, 22, and 23, 1993, and 37 sheep were removed from the Island. Sixteen were sent to the Sleeping Giant area and 21 to Oregon. A third capture effort on February 10

resulted in the capture of 26 sheep, all of which were transported to Oregon. The total capture and removal effort reduced the sheep population by 130 sheep.

Two sheep died during the capture and transplant operation. On-sight examinations indicate that both sheep were suffocated by the crowding of animals in front portions of an enclosed horse trailer. The two ewes were found dead beneath the pile of sheep as the sheep were sorted and spread out to reduce further loss.

Injuries during the operation were restricted to abrasions and small lacerations due to physical trauma during net gunning. Considerable effort was expended to reduce capture myopathy. After the initial handling sessions, protocols were modified to administer 1 and 2 cc doses of Banamine for analgesia and to reduce inflammation. Severely affected sheep may have been given a subcutaneous injection of Dexamethasone also. Serious capture myopathy was observed most commonly in the adult male bighorns.

Mean temperature of all sheep was 104.94 and ranged from 101.3 to 107.9 degrees Fahrenheit (Fig. 1). ANOVA revealed no significant difference in the mean temperature of males and females. The mean temperature for males was 105.2, while the mean for females was 104.9. Mean temperature declined slightly with age (Fig. 2).

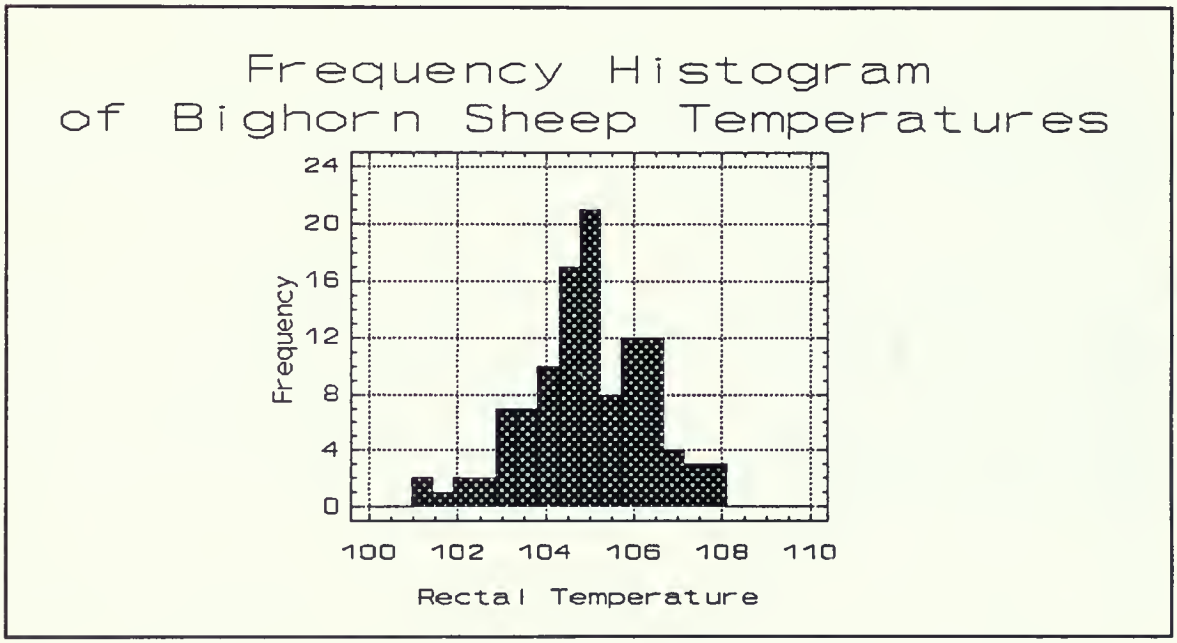


Figure 1. Distribution of rectal temperatures from bighorn sheep captured from Wild Horse Island, 1993.

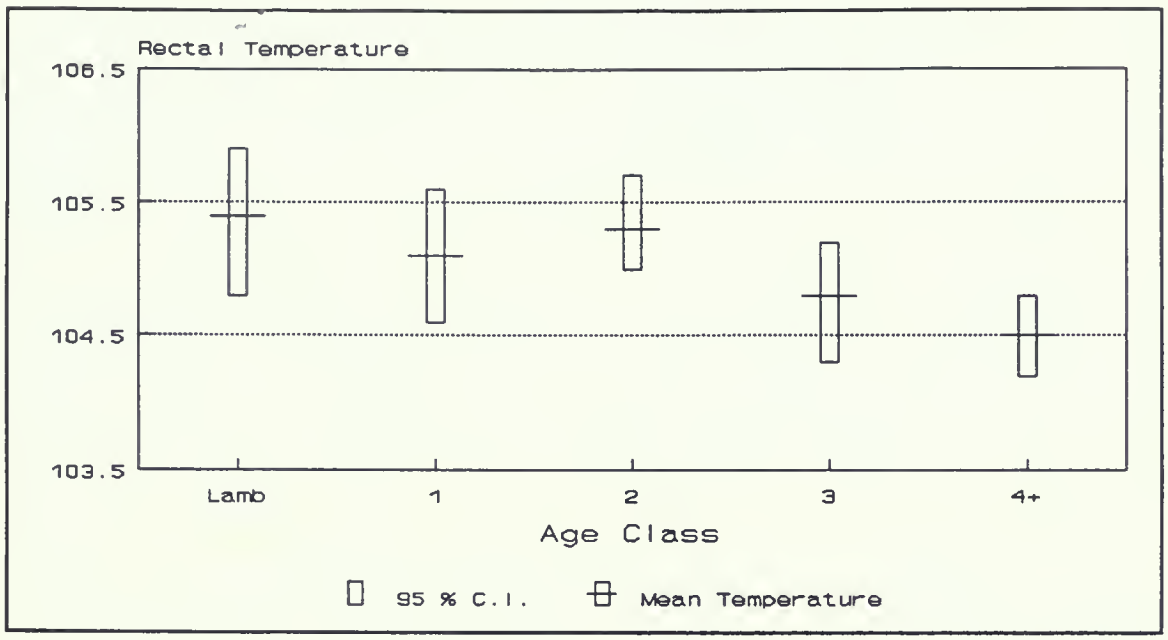


Figure 2. Mean temperature by age class of bighorn sheep captured on Wildhorse Island, 1993.

Serology and Blood Chemistry

Blood was collected from all sheep captured. Blood from eight sheep transported to Washington State University was tested in Washington (see attached report from WSU). The remaining 122 blood samples were submitted to the State of Montana Diagnostic Laboratory.

Serologic testing revealed limited disease activity within bighorn sheep on Wild Horse Island (Table 1). Positive titers were noted for several respiratory viruses, *Haemophilus somnus*, and various serovars of leptospirosis. The frequency of positive titers for the respiratory virus IBR was lower than the 90+ percent commonly reported in other Montana bighorn sheep herds. The viruses IBR and PI3 have been isolated from two Montana sheep herds where pneumonia complex has caused serious mortality in recent years.

*Haemophilus somnus* titers were reported in 35 serology tests. Various titer values were obtained, but the standard for positive and negative titer values varied by serum batch. Twenty-eight titer values greater that 1:8 were detected.

Table 1. Serological summary from bighorn sheep, Wild Horse Island, 1993.

| Serologic Test | Positive/Total | Percent |
|---|---|---|
| Brucella abortus | 0/122 | 00.0 |
| Brucella ovis | 0/122 | 00.0 |
| Anaplasmosis | 0/119 | 00.0 |
| Blue Tongue | 0/120 | 00.0 |
| Infectious Bovine Rhinotracheitis Virus | 43/122 | 35.2 |
| Bovine Viral Diarrhea | 0/122 | 00.0 |
| Para Influenza 3 | 13/122 | 10.7 |
| Bovine Respiratory Syncytial Virus | 17/63 | 27.0 |
| Leptospira pomona | 1/122 | 0.8 |
| Leptospira hardjo | 0/122 | 00.0 |
| Leptospira grippotyphosa | 0/122 | 00.0 |
| Leptospira autumnalis | 9/122 | 7.4 |
| Leptospira icterohemorrhagia | 0/122 | 00.0 |
| Leptospira canicola | 0/122 | 00.0 |
| Leptospira tarassovi | 12/122 | 9.8 |
| Leptospira bratislava | 10/122 | 8.2 |
| Epizootic Hemorrhagic Disease | 0/63 | 00.0 |
| Haemophilus somnus | 31/55 | 56.4 |
| Ovine Progressive Pneumonia | 0/122 | 00.0 |

The complement fixation test for anaplasmosis revealed many test positive animals which were not confirmed on a card test. The CF test results for this species were viewed with suspicion. We interpret any positive findings from the CF test to be a false positive resulting from poor test specificity.

One female bighorn sheep had a suspect titer for *Brucella abortus*. The standard plate test reacted positively for brucella, but all other tests including the card, rapid screen, rivanol, and complement fixation were negative. A serum sample was

resubmitted and tested positive again on the standard plate test. There has been no recent evidence of brucellosis for this region of Montana. Given the herd history, other serological evidence, and the absence of other corroborative titers, the results from this plate test must be viewed with some skepticism. Thorne et al. (1982) pointed out that standard interpretations of serologic tests cannot be applied to wild ruminants, and serologic reactions vary with animal species.

Blood chemistry results were difficult to interpret due to the confounding effects that the capture episode and physical restraint had on blood parameters. Blood counts were mostly normal with the exception that HCT, RBC, and WBC values were occasionally higher than normals established by Johnson (unpublished MFWP report). Glucose values were also often elevated due to the capture episodes.

Bacteriologic Culture

One hundred twenty-one pharyngeal swabs were collected and submitted for culture. *Pasteurella hemolytica* was isolated from 58 samples for a prevalence of 47.9%. Isolates were saved to submit for bio-and sero-typing at NVSL. Mixed culture of non-pathogens were detected in 63 (52.1%) cultures. Some of the bacterial colonies identified and isolated may be the result of contamination from the regurgitated rumen contents often observed in the throat and mouth of captured sheep. Bacterial colonies identified included *Streptococcus spp.*, *Staphylococcus spp.*, *Pseudomonas spp.*, *Bacillus spp.*, and *E. coli*.

Fecal Examination

Fecal flotations were conducted on 101 samples (Table 2). The most common ova present were from Trichostrongyles. Parasite ova detected were typical of many North American bighorn sheep populations reported by Becklund and Senger (1967).

Baermans were performed on 113 fecal samples (Table 3). Parasite larvae detected in fecal samples were also typical of those reported by Becklund and Senger (1967). The rate of Protostrongylus infection (100%) is slightly higher than that reported by Forrester and Senger (1964) (92%). Quantitative counts in 58 samples ranged from 0.5 to 482 larvae per gram (LPG). Counts under 25 LPG were found in 67.2% of the samples (Fig. 3). Only 8.6% of the samples had LPG values greater than 100.

Washington State University

Results from testing of eight sheep from Washington State University were not significantly different from those reported for other sheep transported from Wild Horse Island. Bio- and Sero-typing of Pasteurella cultures indicates that biotype T, serotypes 3, or 3,4 were detected.

Table 2. Qualitative Fecal Flotation Results

| Parasite Ova | No. Tested | No. Pos. | % Positive |
|---|---|---|---|
| Cooperia<br>Trichostrongylus<br>Ostertagia | 101 | 77 | 76.2 |
| Haemonchus<br>Nodular | 101 | 32 | 31.7 |
| Chabertia<br>Bunostomum | 101 | 2 | 2.0 |
| Nematodirus | 101 | 40 | 39.6 |
| Marshallagia | 101 | 39 | 38.6 |
| Trichuris<br>Capillaria | 101 | 3 | 3.0 |
| Strongyloides | 101 | 10 | 9.9 |
| Coccidea | 101 | 21 | 20.8 |

Table 3. Qualitative Baerman Results

| Parasite Larvae | No. Tested | No. Pos. | % Positive |
|---|---|---|---|
| Protostrongylus | 113 | 113 | 100.0 |
| Coccidea | 55 | 12 | 21.8 |
| Hookworm | 55 | 2 | 3.6 |
| Trichostrongylus | 55 | 2 | 3.6 |
| Trichuris | 55 | 2 | 3.6 |

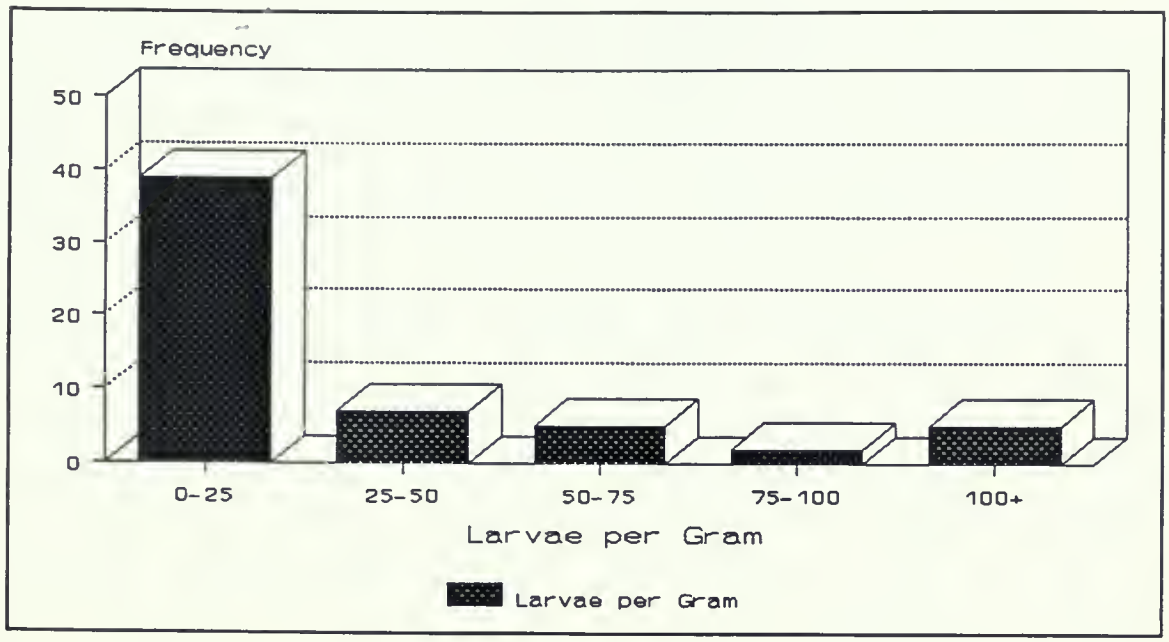


Figure 3. Results from Baerman tests for protostrongylus in bighorn sheep from Wild Horse Island, 1993.

Problems and Solutions

The most significant mechanical problem was the absence of dividers in each transport trailer. Dividers installed in these trailers would reduce the problem of sheep crowding into one corner of transport trailers causing additional heating and potential injury or suffocation of subordinate sheep.

Capture myopathy posed a problem for some sheep following the net gunning episode. Abnormal blood profiles and differentials were indicative of the stress induced myopathy. The use of Banamine and Dexamethasone in treatment protocols aided in the recovery from myopathy. Other methods which would reduce stress include removing the animals from the drop site and reducing sensory stimulus around the holding site before transport.

Controlling body temperature became a problem for many sheep. Body temperatures tended to increase as the day progressed. This was probably a result of increased ambient air temperature and the increased chase involved with each capture as sheep on the island became progressively aware of capture efforts.

A high lungworm prevalence was noted in this sheep herd. Treatment with injectable ivermectin probably provided the desired reduction in parasite load for sheep transported to other locations.

Slinging sheep in the upside down position could cause sheep to aspirate rumen contents. Coughing was often observed in sheep after the first two capture efforts, perhaps as the lungs were attempting to clear rumen content. These symptoms frequently continued for several hours following the capture. During the third capture effort, all sheep were transported inside the helicopter in an upright position. The incidence of coughing was substantially reduced. Methods to sling the sheep, or transporting inside the aircraft, in the upright position should be considered for all future handling episodes.

The suspect brucellosis titer observed for one of 130 sheep caused the issuance of a quarantine notice from the Montana Department of Livestock. The interpretation of serologic data from wild ungulates is, as yet, still unrefined. The issuance of quarantine did not cause specific problems but exemplifies the need for continued cooperation with wildlife agencies and livestock/agricultural agencies to monitor disease through established field protocols, develop specific guidelines for interpretation of serologic evidence from various wildlife species, establish herd health histories, and implement appropriate responses to potential disease problems during or following transportation of animals.

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